AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 21 NOVEMBER, 1938 NUMBER 11

INCLUSION BLENNORRHEA

A STUDY OF THE PATHOLOGIC CHANGES IN THE CONJUNCTIVA AND CERVIX*

ALSON E. BRALEY, M.D.
Iowa City, Iowa

Inclusion blennorrhea is a nonbacterial conjunctivitis of the newborn, differentiated by Lindner[1] from gonorrheal ophthalmia, with which it was at first confused. Its virus etiology now appears established on the basis of (1) the positive-filtration experiments of Gebb,[2] Botteri,[3] Thygeson,[4] and Tilden and Gifford;[5] (2) the occurrence of epithelial-cell inclusion bodies like those of psittacosis, a proved virus disease; and (3) the failure of the agent to grow on bacteriological media.

The first indication that the infection of the baby is derived from a genital disease of the mother came from the finding of Fritsch, Hofstätter, and Lindner[6] that secretion from the vaginas of mothers whose babies had inclusion blennorrhea was infectious for the eyes of baboons. The experimental disease was like that produced by direct transfer from the eye of the baby. These investigators produced a similar conjunctivitis in baboons with gonococcus-free secretion obtained from cases of urethritis in men.

Subsequently Linder,[7] Halberstädter and Prowazek,[8] Heymann,[9] and Thygeson[4] were able to demonstrate typical epithelial-cell inclusions in scrapings from the genito-urinary tracts of mothers of infected babies. Hamburger[10] recently expressed the opinion that the virus was usually present in the vagina and external genitalia and only infrequently in the cervix, but he offered no experimental proof. Thygeson and Mengert,[11] on the other hand, localized the disease in the cervix. They demonstrated epithelial-cell inclusions as well as free elementary and initial bodies in scrapings from the cervix and were unable to find them in other parts of the genito-urinary tract, including the uterus. They found that inoculation of the cervix with material from inclusion blennorrhea produced infection, that inoculation of the vaginal epithelium produced none.

The present study was undertaken with the following objectives: (1) to determine the pathological changes in conjunctival and cervical tissues infected with inclusion-blennorrhea virus, and (2) to localize the virus.

METHOD OF STUDY

The material for study was obtained from eight babies with inclusion blennor-

* Part of a study being conducted under a grant from the John and Mary R. Markle Foundation in the Department of Ophthalmology, State University of Iowa, College of Medicine.

Read before the American Association for Research in Ophthalmology, at San Francisco, California, June, 1938.

FIG. 1 (BRALEY). NORMAL CERVIX. NARROW TRANSITIONAL ZONE.
FIG. 2 (BRALEY). INCLUSION BODIES IN LARGE POLYGONAL CELLS OF CONJUNCTIVA (WILDER SILVER STAIN).
FIG. 4 (BRALEY). CERVIX INFECTED WITH VIRUS OF INCLUSION BLENNORRHEA (HEMATOXYLIN AND EOSIN STAIN).
FIG. 5 (BRALEY). HIGH-POWER AREA IN FIGURE 4. INCLUSION BODY IN CERVICAL EPITHELIAL CELL (HEMATOXYLIN AND EOSIN STAIN)

rhea and from the mothers of six of the eight. All of the infants had typical clinical inclusion blennorrhea in which inclusion bodies were demonstrable in smears of conjunctival epithelial cells. Biopsies were taken from the lower fornix and the retrotarsal fold, and from the cervix of the mother, on the day the disease was diagnosed. They were fixed in absolute methyl alcohol for 24 hours, then immersed successively in absolute ethyl alcohol for two to three hours, in xylol for one-half to one hour, finally in xylol paraffin. They were then embedded in paraffin, cut at five microns, and stained in Giemsa tissue stain, hematoxylin and eosin, and Wilder silver stain.

Histology

Conjunctiva

For convenience the conjunctiva may be divided into epithelium, substantia propria, and subconjunctival connective tissue, which contains the adenoid layer.

The earliest changes appear to occur in the epithelium. The normal epithelium of the retrotarsal fold is a mixture of thin stratified squamous and stratified columnar epithelium, two to three cell layers thick. After infection it becomes entirely thin stratified squamous, three to four cell layers thick. The basal cells become somewhat swollen and more columnar, the polyhedral cells just above become large and pale-staining. The surface is covered by one or two layers of flat epithelial cells which are undergoing changes in nucleus and cytoplasm, giving the appearance of degeneration; they are later desquamated. The goblet cells usually present in the fornix are rarely seen. The epithelium is infiltrated with neutrophilic polymorphonuclear leukocytes and a few small lymphocytes, only rarely with eosinophilic or basophilic polymorphonuclear leukocytes.

Normally the substantia propria is composed chiefly of medium-sized and small blood vessels and some moderately dense connective tissue. Beneath this is the adenoid tissue consisting of collections of lymphocytes in a loose connective tissue. In inclusion blennorrhea the blood vessels of the substantia propria and subconjunctiva are markedly congested. The tissue is edematous and densely infiltrated with lymphocytes and polymorphonuclear leukocytes, the latter usually neutrophilic, occasionally eosinophilic or basophilic, and occurring, for the most part, in the epithelium between the epithelial cells, and in the substantia propria. At times the substantia propria is densely infiltrated with polymorphonuclear leukocytes, especially in patients having a profuse purulent discharge from the conjunctiva. The adenoid tissue in the subconjunctiva becomes very hyperplastic and densely infiltrated with lymphocytes, most of which are small round cells with very little cytoplasm. Deep in the tissue are occasional lymph follicles filled with lymphoblasts: large, pale-staining cells with a good deal of pale-blue-staining cytoplasm. No evidence of degeneration of the follicles could be demonstrated. This is the same type of subepithelial cellular infiltration seen in any acute conjunctivitis.

The connective tissue of the substantia propria and subconjunctiva could best be seen in the silver stain. It supports the blood vessels and lymphoid structures and is very thin. A small amount of very fine connective tissue is present in the lymph follicles. No evidence of scar-tissue formation could be demonstrated.

Cervix

The histologic changes in the cervix are somewhat difficult to evaluate in view of the fact that all clinically normal cervices histologically show varying amounts of subepithelial inflammation. In order to establish a normal cervix for comparative purposes, 25 clinically normal specimens from women of child-bearing age

were examined. They were obtained from three sources: some at post-mortem examination, some from the files of the Department of Pathology, and some from the Department of Obstetrics and Gynecology, all of the latter having been removed in the course of performing total hysterectomies for disorders in the uterus; for example, leiomyomata. All 25 cervices were similar histologically (fig. 1).

The cervix may be divided histologically into three parts: (1) Endocervix. This innermost part of the cervix is lined with columnar epithelium, characteristically tall and forming simple glands which are rather shallow and often filled with a granular, very pale-staining substance that resembles mucus. The substantia propria is composed of vessels and supportive connective tissue. The submucosa is dense, collagenous connective tissue. Inflammatory cells are rarely found in this part of the cervix although an occasional lymphocyte or polymorphonuclear leukocyte may be seen in the substantia propria.

(2) Transitional zone. Near the external os of the cervix the columnar epithelium changes into a type which might be called transitional between the columnar epithelium of the endocervix and the stratified squamous of the vulva and exocervix. The width of this area varies in different cervices but is usually narrow. The epithelium here consists of two to five layers of cells. The basal cells are columnar or cuboidal; above them are large polyhedral cells and then one or more layers of flat cells. The substantia propria is very vascular and beneath it lies a layer of adenoid tissue of varying thickness. In all of the cervices studied this area contained many inflammatory cells, most of them lymphocytes occurring in the adenoid layer and in the substantia propria. Occasionally lymph follicles were seen in the adenoid layer. The submucosa again is dense, collagenous connective tissue.

(3) Exocervix. The third zone in the cervix is the exposed part, or exocervix. It is covered by a thick layer of stratified squamous epithelium which varies from 10 to 20 cells thick. The surface cells are keratinized and constantly desquamating and are the ones seen in the discharge from the vagina. The substantia propria is rather thin here and, although vascular, contains very few inflammatory cells.

When the cervix becomes infected with the virus of inclusion blennorrhea, all the changes seem to occur in the so-called transitional zone. The epithelium becomes swollen and hyperplastic, especially near the endocervix, and is lightly infiltrated with polymorphonuclear leukocytes. The vascular substantia is infiltrated with polymorphonuclear leukocytes and lymphocytes and the vessels are congested. The submucosal connective tissue is densely infiltrated with lymphocytes. The endocervix and exocervix, on the other hand, show little or no change.

One would anticipate from the histologic picture of the virus-infected cervix that with such a narrow zone involved there would be few if any clinical symptoms. This supposition was borne out in the six cases studied: all denied having had discharges or any clinical symptoms of cervicitis.

Demonstration of inclusion bodies

In the conjunctiva numerous inclusions are readily demonstrable in preparations of virus-infected epithelium which have been fixed in absolute methyl alcohol. Zenker's fluid and formalin were also used as fixatives but proved very unsatisfactory for cell-inclusion demonstration.

The elementary and initial bodies of the inclusions stained a pale blue with hematoxylin, a deep blue with Giemsa stain, and brownish black with silver stain. The elementary bodies are minute spheres and are uniform in size. They measure about 0.25 microns when stained with Giemsa

and silver stain, are somewhat smaller when stained with hematoxylin. The larger size of the Giemsa and silver-stained bodies may be due to adsorption by the particles of the methylene blue and silver; when staining with hematoxylin the adsorbed portion is removed by acid alcohol. The initial bodies vary somewhat in size and are usually from two to three times the size of the elementary bodies.

Cellular inclusions vary considerably in size but are readily differentiable from nuclear chromatin granules or degenerated cells on the basis of the uniformity in size and shape of their elementary-body components; chromatin materials vary widely in both size and shape. The initial bodies are less uniform in size but are usually differentiable from chromatin débris on account of their close association with the elementary bodies; they often occur in the same inclusion.

The elementary and initial bodies of the inclusions as seen in section occupy a position along one margin of the inclusion cavity forming a half-moon appearance (fig. 2). This may be explained from the fact that the elementary bodies normally lie in a glycogen-containing matrix, readily stainable with iodine in epithelial smears (Rice,[12] Thygeson[13]). In these preparations the elementary bodies of the inclusion can be seen as clear dots lying in the stained matrix (fig. 3). Several attempts were made to stain the sectioned tissues with iodine after removal of the paraffin, but no inclusions could be demonstrated. It was assumed that the matrix of the inclusion had been dissolved in the preparation of the tissue for section.

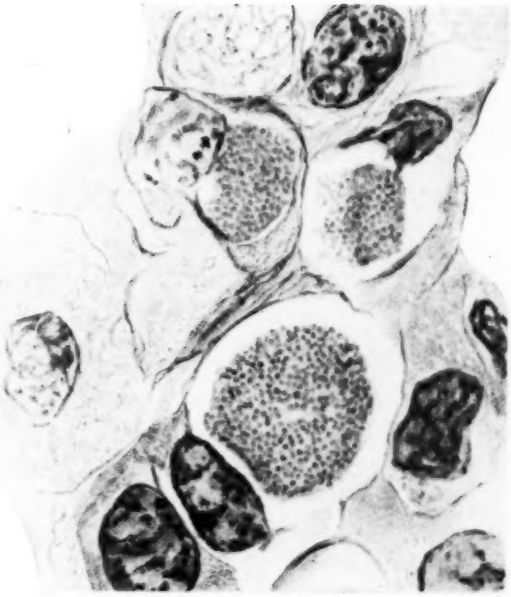
Inclusion bodies were found only in epithelial cells, but scattered through the substantia propria and the subconjunctiva three very interesting types of cells were noted and later identified by examination of living conjunctival tissue (neutral-red technique). (1) The first was a small round cell with a round or slightly oval nucleus and a cytoplasm that was filled with tiny violet-staining granules, smaller than elementary bodies. It was found only in Giemsa-stained preparations. This was the mast cell. (2) The second was an oval, somewhat irregularly shaped cell with an oval nucleus. Its cytoplasm contained large, irregularly shaped, scattered, violet and red granules which varied in size and number. It was the macrophage. (3) The third was spindle-shaped with an oval nucleus and a few large irregularly shaped red granules: the fibroblast. None of the granules of these cells could be confused with the elementary or initial body of the epithelial-cell inclusion.

The inclusion bodies occur almost entirely in the large polygonal "wing" cells of the epithelium just above the basal layer. Small inclusions are found very rarely in the basal cells and in the moderately flat cells near the surface of the epithelium. The inclusion bodies in the "wing" cells are usually large and may push the nuclei to the periphery. These large polygonal cells just above the basal layer seem to have the greatest power of oxidation and reduction and also of phagocytosis, considerations which will be the subject of a subsequent report. The localization of the inclusions in the deeper layers of the conjunctiva and not in the more superficial cells may explain the fact that first epithelial scrapings very often show only a few inclusions while subsequent ones show many.

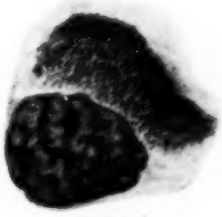
In the cervix the inclusions are many times more difficult to demonstrate than in the conjunctiva. None were demonstrated in the columnar epithelium of the endocervix, nor in the stratified squamous epithelium of the external cervix, nor in the epithelial cells in scrapings from the vagina and the external cervix. They were found only in the zone of transitional epithelium described above (figs. 4 and 5). This epithelium resembles very closely the conjunctival epithelium and the inclu-



GIEMSA STAIN



H & E STAIN



SMEAR

FIG 3 (BRALEY). CONJUNCTIVAL EPITHELIAL CELLS CONTAINING LARGE INCLUSION BODIES (GIEMSA AND HEMATOXYLIN AND EOSIN STAINS).

sion bodies are again located in the large polygonal cells just above the basal layer. The inclusions at this site are very much like those seen in the conjunctiva except that they are usually smaller. They are more easily demonstrated in epithelial scrapings than in biopsies, both of which must be taken from a zone just inside the external os of the cervix. Biopsies of this area are difficult to obtain by ordinary methods.

Conclusions

1. The inclusion bodies of inclusion blennorrhea can be demonstrated in fixed tissue of the conjunctiva and of the cervix.

2. The type of epithelium containing the bodies is the same in the cervix and the conjunctiva.

3. The inclusions occur almost exclusively in the large polygonal "wing" cells just above the basal layer.

4. Hyperplasia, hypertrophy, and desquamation of the epithelium are the predominant histological changes in the virus-infected tissues.

5. The subepithelial infiltrate of inflammatory cells is nonspecific.

6. Disintegration of follicles and scarring do not occur.

Bibliography

[1] Lindner, K. Gonoblennorrhöe, Einschlussblennorrhöe und Trachom. Arch. f. Ophth., 1911, v. 78, p. 245.

[2] Gebb, H. Ztschr. f. Augenh., 1914, v. 31, p. 475.

[3] Botteri, A. Klin. M. f. Augenh., 1912, v. 50, p. 653.

[4] Thygeson, P. Etiology of inclusion blennorrhea. Amer. Jour. Ophth., 1934, v. 17, p. 1019.

[5] Tilden, E., and Gifford, S. Filtration experiments with the virus of inclusion blennorrhea. Arch. of Ophth., 1936, v. 16, July, pp. 51-54.

[6] Fritsch, H., Hofstätter, A., and Lindner, K. Experimentelle Studien zur Trachomfrage. Arch. f. Ophth., 1910, v. 76, pp. 36 and 661.

[7] Lindner, K. Zur Aetiologie der gonokokkenfreien Urethritis. Wien. klin. Woch., 1910, v. 1, p. 284.

[8] Halberstädter, L., and Prowazek, S. Ueber die Bedeutung der Chlamadozoen bei Trachom und Blennorrhöe. Berl. klin. Woch., 1910, v. 47, p. 661.

[9] Heymann, B. Ueber die Fundorte der Prowazekschen Körperchen. Berl. klin. Woch., 1910, v. 47, p. 663.

[10] Hamburger, F. Die Rolle des Einschlussvirus am Auge des Neugeborenen und am Genitale der Frau. Arch. f. Ophth., 1934, v. 133, p. 90.

[11] Thygeson, P., and Mengert, W. F. The virus of inclusion conjunctivitis. Arch. of Ophth., 1936, v. 15, p. 377.

[12] Rice, C. E. The carbohydrate matrix of epithelial-cell inclusions in trachoma. Amer. Jour. Ophth., 1936, v. 19, Jan., pp. 1-8.

[13] Thygeson, P. The matrix of the epithelial-cell inclusion body of trachoma. Amer. Jour. Path., 1938, v. 14, July, p. 455.

Discussion

Dr. Conrad Berens: Have you attempted to cultivate the virus of inclusion conjunctivitis on cultured corneal or conjunctival epithelium?

Dr. Braley: We have not tried to culture the inclusion-blennorrhea virus on corneal or conjunctival epithelium as yet. That will be done this winter. We are attempting to culture trachoma virus on living epithelium, and have been unsuccessful so far.

Dr. Phillips Thygeson: How does the virus get through the superficial layers of cells and involve only the polyhedral cells?

Dr. Braley: Normally the conjunctival epithelium of a baby is only two or, rarely, three cell layers thick. After infection with the virus this epithelium becomes at least four cell layers thick, and the superficial cells may desquamate. The infection of the epithelium by the virus occurs early

when the epithelium is thin; consequently, the superficial cells are formed by proliferation of the normal cells and not the infected cells. These normal cells then cover the cells which contain the virus.

TREATMENT OF EXPERIMENTALLY PRODUCED EXOPHTHALMOS WITH THYROXIN AND OTHER IODINE COMPOUNDS*

GEORGE K. SMELSER, PH.D.
New York

Of the many attempts that have been made to control exophthalmos medically, iodine compounds have been most commonly employed. They have been used in cases of progressive or malignant postthyroidectomy exophthalmos. The results of the clinical use of iodides, diiodotyrosine, and thyroid gland have frequently been disappointing and inconsistent. The literature, consisting of reports of cases variously treated, is extensive; therefore, only a few representative reports are cited here.

Thompson and Thompson[1] reported cases in which exophthalmos first developed during iodine administration. Haines,[2] however, treated postthyroidectomy exophthalmos with iodide and thyroid alternately, and reported successful control of the proptosis. Wahlberg[3] and Ruedemann[4] found that thyroid administration reduced or restrained this type of exophthalmos, whereas similar treatment by Rynearson[5] and Zimmerman[6] did not decrease the protrusion. Thomas and Woods[7] reported no effects of either Lugols or thyroid extract on exophthalmos.

Injection of anterior-pituitary extract into the thyroidectomized guinea pigs produces an exophthalmos closely approaching that found clinically. The condition produced is a definite proptosis, much more than just a widened palpebral fissure, and the displacement of the bulb from the orbit can be demonstrated in roentgenograms. Moreover, the exophthalmos persists *post mortem*. The retrobulbar tissues (lacrimals, muscles, and fat) increase in weight in such animals. The fat and, to a lesser extent, the muscles are edematous, presenting histologically the same condition as that found in the orbital fat and muscles of patients with clinical progressive exophthalmos (Smelser[8]).

Production of exophthalmos similar in many respects to that found clinically provides an opportunity to determine the effect of various treatments under readily controlled conditions. Treatment of experimental exophthalmos with iodine compounds would serve, first, to test its similarity to the clinical condition, and, second, possibly indicate the value of such treatment if applied clinically.

EXPERIMENTAL

Seventy-one young adult female guinea pigs were thyroidectomized and, after a recovery period of 15 to 20 days, given daily injections of sodium iodide, diiodotyrosine, or thyroxin. Following 10 to 14 preliminary injections, approximately two thirds of the animals were injected daily with an anterior-pituitary extract in addition to the iodine compounds. The re-

---

* From the Institute of Ophthalmology, Columbia University.

Read before the American Association for Research in Ophthalmology, at San Francisco, June, 1938.

mainder served as controls to demonstrate the effect of continued administration of the iodine compound on the orbital tissues. In addition, eight uninjected thyroidectomized controls were used. Preliminary injections were given to allow ample time for effective action of the thyroxin, which achieves its maximum effect sometime after the first injection. The pituitary extract used was a partially purified alkaline extract of beef anterior lobes prepared as in earlier experiments (Smelser[8]). The daily dosage was equivalent to 200 mg. acetone-dried anterior-pituitary powder, an amount previously shown to be sufficient to produce exophthalmos. This preparation contained gonad, growth, thyroid, and adrenal stimulating factors. The amount of extract given daily was purposely small, so that only a slight degree of exophthalmos could be expected. Under such conditions any effect of the iodine compounds, which were administered in excess, would be readily observed. The pituitary injections were continued for 60 days except in those cases in which exophthalmos had been produced earlier and maintained for 8 or 10 days.

TABLE 1

EFFECT OF SODIUM IODIDE ON ORBITAL TISSUES OF THYROIDECTOMIZED GUINEA PIGS*

Treatment	Globe mg.	Crbital Fat mg.	Dorsal Lacrimal mg.	Ventral Lacrimal mg.	Eye Muscles mg.	Total Retrobulbar Tissue mg.	Body Weight gm.	Number of Animals
Sodium iodide	480	39	256	222	81	599	489	7
ϵ_M	4.5	2	18	14	2	27	35	
No injection	458	29	355	231	75	690	482	8
ϵ_M	6.5	2	7	6	3	11	17	
Difference	22	10	99	9	6	91	7	
$\epsilon_{Diff.}$	8	3	19	15	3	29	38	

Sodium-iodide series. Twenty-two animals were injected daily with 200 mg. of sodium iodide. Although this huge dose caused local induration, in some cases, it was not sufficiently injurious to cause loss of body weight, although twice this amount was definitely toxic. Presumably a large portion of the injected iodide was excreted. Injection of this amount of iodide produced, in four to seven days, a widening of the palpebral fissure, so that a band of sclera could be seen completely surrounding the cornea. In addition to the "stare" a slight proptosis was evident. This condition, although absolutely definite, occurred in about one half of the animals and disappeared with continued injections. After the preliminary injection period, pituitary extract was administered to 15 animals, while 7 were reserved as controls. In no cases were pituitary injections given while the "stare" and proptosis described above persisted.

Pituitary exophthalmos became definite

* It is imperative that data such as these be treated with statistical tests of significance.

$$\epsilon = \sqrt{\frac{\Sigma d^2}{N-1}}, \quad \epsilon_M = \sqrt{\frac{\epsilon^2}{N-1}}$$

and

$$\epsilon_{Diff.} = \sqrt{\frac{\epsilon_A^2}{N_A - 1} + \frac{\epsilon_B^2}{N_B - 1}}$$

Where M = the arithmetic mean
d = the deviation of each value from the average of the group
Σ = sum
N = the number of cases in the group
When the difference between two means exceeds 2 to 3 times the $\epsilon_{Diff.}$ it is generally accepted as significant.

in most of the animals within 30 days, although two required nearly twice this injection period, and two others never appeared definitely exophthalmic. Of the 13 exophthalmic animals, only a few could be regarded as extreme, though all could be readily distinguished from the normal or iodide controls.

was markedly reduced by the iodide injection, which accounts entirely for the decreased retrobulbar tissue of this group. The slightly heavier orbital fat of the sodium-iodide group did not significantly affect the difference. There was no indication of the cause of the transitory lid retraction and slight proptosis which occurred in some of the animals early in the experiment. However, these manifestations had entirely disappeared long before autopsy in most instances. It seems probable that a different mechanism is involved than in pituitary exophthalmos.

TABLE 2

EFFECT OF ANTERIOR PITUITARY EXTRACT ON THE ORBITAL TISSUES OF THYROIDECTOMIZED GUINEA PIGS TREATED WITH SODIUM IODIDE

Treatment	Globe mg.	Orbital Fat mg.	Dorsal Lacrimal mg.	Ventral Lacrimal mg.	Eye Muscles mg.	Total Retrobulbar Tissue mg.	Body Weight gm.	Number of Animals
Sodium iodide	480	39	256	222	81	599	489	7
ϵ_M	4.5	2	18	14	2	27	35	
Sodium iodide and pituitary	487	61	441	261	93	856	509	15
ϵ_M		2	21	12	2	28	22	
Difference	7	22	185	39	12	257	20	
$\epsilon_{Diff.}$		3	28	18	3	39	41	

At autopsy the orbital contents were dissected, weighed, and fixed for histological observation. Reference to table 1* reveals that injection of sodium iodide alone was not without effect on the orbital contents. The weight of the total retrobulbar tissue of the iodide-treated animals averaged 599 mg., whereas the mean of the untreated thyroidectomized controls was 690 mg., a statistically significant difference. Inspection of the data reveals that the extraocular muscles and ventral lacrimals were not involved in the decrease. The dorsal lacrimal, however,

Animals receiving both sodium iodide and anterior-pituitary extract showed striking differences in the orbital contents from the uninjected controls and those receiving sodium iodide (table 2). The pituitary injection caused a 43-percent increase in the total retrobulbar tissue. The dorsal lacrimal, extraocular

Fig. 1 (Smelser). Photograph of a normal guinea pig.

Fig. 2 (Smelser). Enophthalmos following thyroxin injections—guinea pig 595.**

Fig. 3 (Smelser). Exophthalmos produced in hyperthyroid guinea pig 515 with the minimal amount of pituitary extract; see graph 1.

Fig. 4 (Smelser). Normal guinea pig, showing the position of the eye *post mortem* after removal of the skin and lids.

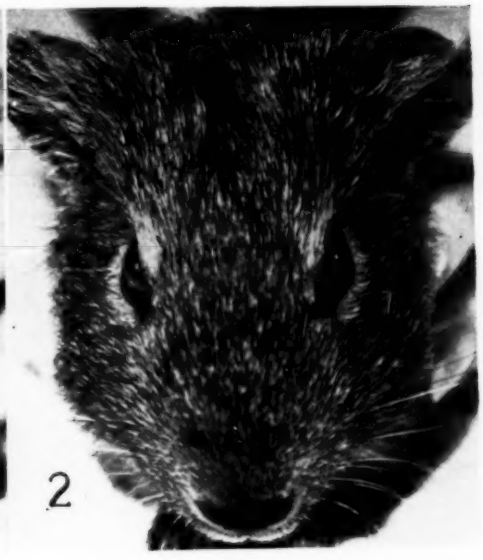
Fig. 5 (Smelser). Enophthalmos produced by thyroxin, demonstrated *post mortem* with skin and lids removed. Note the position of the globe relative to the skull.

Fig. 6 (Smelser). Exophthalmos produced in hyperthyroid guinea pig with minimal amount of pituitary extract. The skin and lids were removed to show the relation of the eye to the skull. Compare with figures 4 and 5.

* See footnote, page 1209.

** See footnote, page 1214.













Figs. 1-6 (Smelser). See legends on opposite page.

muscles, and orbital fat were all involved in this increase; the increased ventral lacrimal weight was of doubtful significance statistically. The dorsal lacrimal, because of its size, contributed greatly to the total weight increase, but the fat reacted most consistently. The extraocular muscles also showed a highly consistent increase in weight. The high incidence of exophthalmos, 86 percent, with the addition of the marked change in orbital tissue, demonstrates that this iodide does not inhibit the development of pituitary exophthalmos.

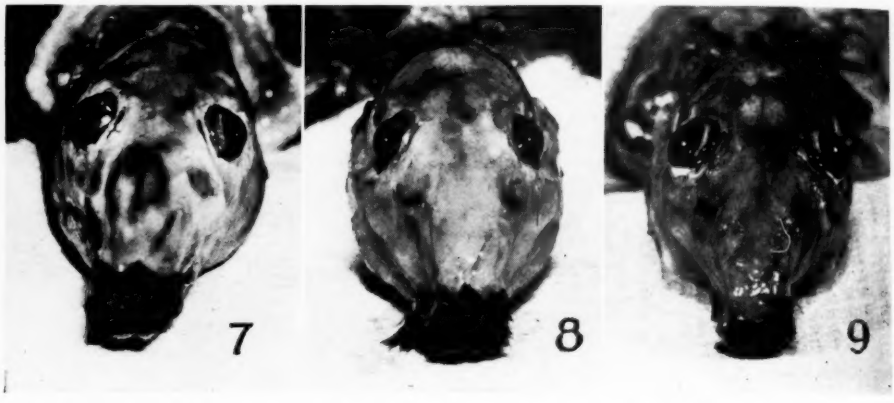


Fig. 7 (Smelser). Same as figure 4.

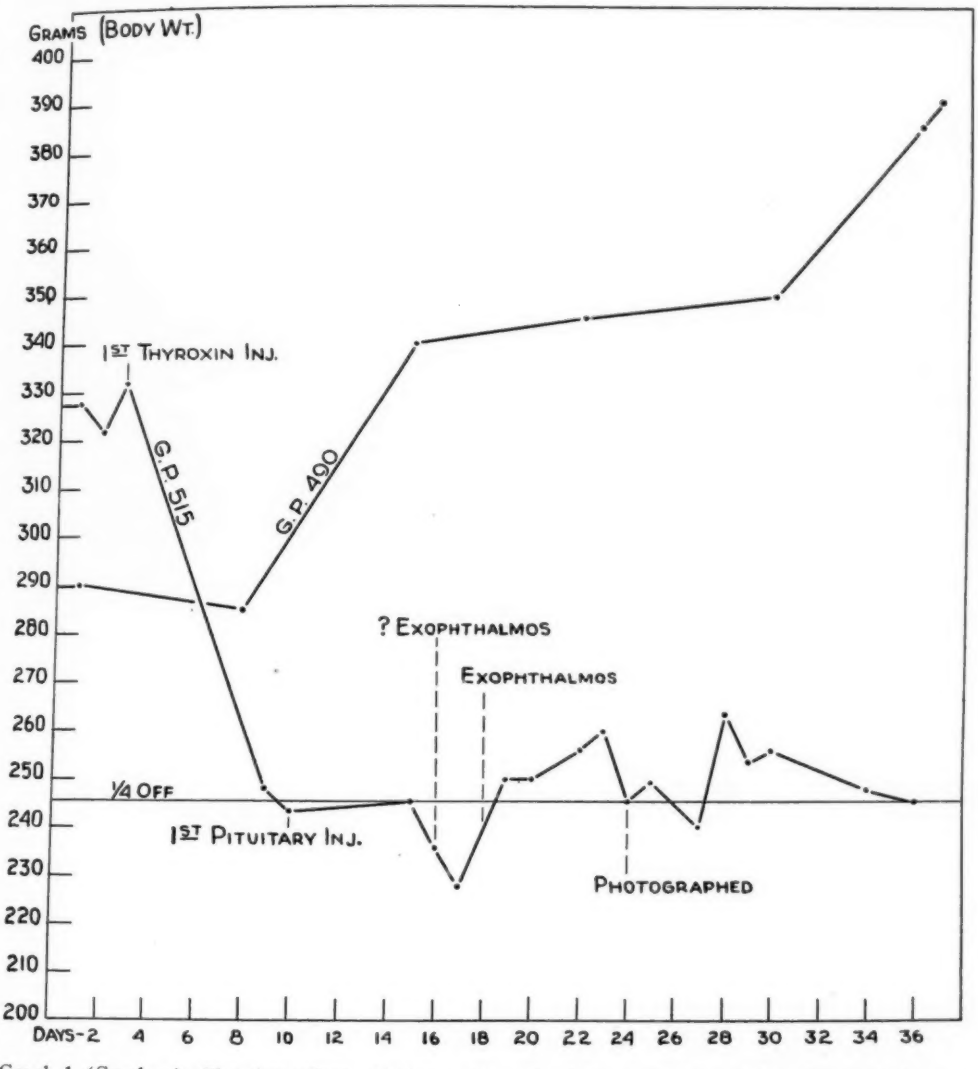
Fig. 8 (Smelser). Same as figure 5.

Fig. 9 (Smelser). Same as figure 6.

Thyroxin series. Thirty-four female guinea pigs were injected daily with 0.1 mg. thyroxin, producing a marked loss of body weight during the preliminary injection period. Because of deaths due to the extreme hyperthyroidism induced, injections were interrupted, usually for one or two days, when one fourth the body weight had been lost. As a result of this procedure, the weight of the thyroxin-treated animals rapidly decreased during the first part of the experiment, and was maintained at about three fourths of the original body weight. Had it not been for the thyroxin injections the weight of these animals would have tended to rise (graph 1). The extreme degree of the hyperthyroidism induced is shown by the high mortality rate in this group. There were 17 deaths and 34 survivors in this series in contrast to four deaths in the sodium-iodide, diiodotyrosine, and control experiments combined.

Injection of thyroxin had a marked and consistent effect on the eyes. As the decrease in body weight progressed, the eyes became at first slightly, and later markedly enophthalmic. Usually the more extreme cases were accompanied by a ptosis. The ptosis and enophthalmos so produced was comparable, although usually more marked, with that resulting from the removal of the cervical-sympathetic ganglion. The X-ray technique devised for measuring exophthalmos (Smelser[8]) is applicable to demonstrating hyperthyroid enophthalmos. By this method the apex of the cornea of a normal guinea pig can be shown to lie about two millimeters beyond the zygomatic arch. A silver marker, placed on the cornea of an enophthalmic guinea pig is shown in a roentgenogram to lie just outside, or superimopsed upon, the zygomatic. At autopsy, after removal of the skin and lids, the globes were seen to be quite sunken in comparison with post-mortem skinned normal animals (figs. 4, 5,

7, and 8). The weights of the orbital contents provide an explanation of the enophthalmos, for the total retrobulbar tissue was reduced from 690 mg. to 587 mg. statistically. Due to the inclusion of several unusually high orbital-fat weights, the mean and mean deviation of this group were greater than might have been ex-



Graph 1 (Smelser). Showing effect of 0.1 mg. thyroxin daily on body weight of a typical case (see fig. 3). The diiodotyrosine-treated control demonstrates the normally expected weight gain.

(table 3). All of the orbital structures were decreased in weight, but the dorsal-lacrimal and extraocular muscles were most marked and consistent in their reaction. The ventral lacrimal suffered by a slight reduction which was insignificant pected in view of the marked effect on other tissues. Because of the thyroxin injections, the body weight of this series is below that of the uninjected controls. However, the initial weights and the weight of the eyeballs at autopsy were

TABLE 3

EFFECT OF THYROXIN ON ORBITAL TISSUES OF THYROIDECTOMIZED GUINEA PIGS

Treatment	Globe mg.	Orbital Fat mg.	Dorsal Lacrimal mg.	Ventral Lacrimal mg.	Eye Muscles mg.	Total Retrobulbar Tissue mg.	Body Weight gm.	Number of Animals
Thyroxin	472	23	291	210	63	587	349	13
ϵ_M	8	1.6	7	8	2	14	12	
No injection	458	29	355	231	75	690	482	8
ϵ_M	6.5	2	7	6	3	11	17	
Difference	14	6	64	21	12	103	133	
$\epsilon_{Diff.}$	10	2.3	10	10	3.1	18	20	

similar, indicating that the comparison made is a fair one.

The first pituitary injections which were made in this series after the preliminary thyroxin treatment had markedly affected body weights (graph 1), produced enophthalmos, and in most cases a ptosis (fig. 2*).

Twenty-one animals were given both pituitary and thyroxin; of these, 11 became exophthalmic. The degree of exophthalmos developed in these cases varied extremely, being marked in a few (figs. 1, 2, and 3), even when the hyperthyroidism, as indicated by weight loss (graph 1), was extreme. In most cases the proptosis was slight, except in comparison with thyroxin-treated enophthalmic controls. The time of onset of exophthalmos varied widely, but developed in about half the cases within the first 20 days. In several instances exophthalmos evolved with startling rapidity in animals previously enophthalmic.

During injections the proptosis was not so constant as in the other series. Several cases of definite exophthalmos, developed early, later became extremely questionable. Among the 10 cases in which no protrusion was produced, several could definitely be classed as enophthalmic, revealing no trace of pituitary action.

In these studies of exophthalmos, persistence of the protrusion *post mortem* has been emphasized. In all but a very few of this group, little or no exophthalmos was evident after removal of the skin and lids. Their condition approximated the

* Photographs of the guinea pigs reproduced in this paper were by Adolph Marfaing.

TABLE 4

EFFECT OF ANTERIOR PITUITARY EXTRACT ON THE ORBITAL TISSUES OF THYROIDECTOMIZED GUINEA PIGS TREATED WITH THYROXIN

Treatment	Globe mg.	Orbital Fat mg.	Dorsal Lacrimal mg.	Ventral Lacrimal mg.	Eye Muscles mg.	Total Retrobulbar Tissue mg.	Body Weight gm.	Number of Animals
Thyroxin	472	23	291	210	63	587	349	13
ϵ_M	8	1.6	7	8	2	14	12	
Thyroxin and pituitary	496	33	383	243	73	733	373	21
ϵ_M	6	1.9	8	8	1.2	15	14	
Difference	24	10	92	33	10	146	24	
$\epsilon_{Diff.}$	10	2.5	10	11	2.4	21	18	

TABLE 5

EFFECT OF THYROXIN AND ANTERIOR PITUITARY EXTRACT ON ORBITAL TISSUES OF THYROIDECTOMIZED GUINEA PIGS

Treatment	Globe mg.	Orbital Fat mg.	Dorsal Lacrimal mg.	Ventral Lacrimal mg.	Eye Muscles mg.	Total Retrobulbar Tissue mg.	Body Weight gm.	Number of Animals
Thyroxin and pituitary	496	33	383	243	73	733	373	21
ϵ_M	6	1.9	8	8	1.2	15	14	
No injection	458	29	355	231	75	690	482	8
ϵ_M	6.5	2	7	6	3	11	17	
Difference	38	4	28	12	2	43	109	
$\epsilon_{Diff.}$	9	2.6	10	10	2.8	19	21	

normal and was exophthalmic only in comparison with the deeply sunken eyes of the thyroxin-treated controls (figs. 4 to 9).

Weights of the orbital tissues substantiated the observations made on the living animals. The pituitary extract was clearly effective in the hyperthyroid animals, increasing the weight of the retrobulbar mass from 587 mg. to 733 mg. The same structures were affected in this series as in the others; namely, one lacrimal, orbital fat, and the extraocular muscles (table 4). When these data are compared, however, with the uninjected thyroidectomized controls, no significant increase is apparent (table 5).

Diiodotyrosine series. Because of the similarity of its structure to thyroxin, diiodotyrosine was used in an additional control series. Fifteen female guinea pigs were injected daily with 0.3 mg. diiodotyrosine;* after 12 to 15 injections, 10 were given anterior-pituitary extract in addition. Injection of this amount of diiodotyrosine had no discernible effect on the eyes or weight of the orbital contents (table 6). Although the amount injected was three times that of thyroxin, no toxic symptoms developed, and gain in body weight was not affected (fig. 1).

Injection of anterior-pituitary extract was fully effective in the animals of this series. Exophthalmos was induced in 8 of the 10 animals injected, in most instances developing within 10 to 30 days.

* The diiodotyrosine was prepared by Dr. G. L. Foster to whom I am greatly indebted.

TABLE 6

EFFECT OF ANTERIOR PITUITARY EXTRACT ON THE ORBITAL TISSUES OF THYROIDECTOMIZED GUINEA PIGS TREATED WITH DIIODOTYROSINE

Treatment	Globe mg.	Orbital Fat mg.	Dorsal Lacrimal mg.	Ventral Lacrimal mg.	Eye Muscles mg.	Total Retrobulbar Tissue mg.	Body Weight gm.	Number of Animals
Diiodotyrosine	456	31	366	205	74	677	419	5
ϵ_M		3	11	9	3	18	34	
Diiodotyrosine and pituitary	472	51	442	228	81	807	466	10
ϵ_M		3	9	8	3	17	19	
Difference	18	20	76	23	7	130	47	
$\epsilon_{Diff.}$		4	14	12	4	24	38	

In three cases the injections were continued for 55 to 60 days, since the exophthalmos, though definite, was slight. In two others no apparent protrusion was produced during the 60-day injection period. Weights of the orbital tissues, secured at autopsy, demonstrated that the pituitary injections effected a definite increase in weight of the retrobulbar structures (table 6). The orbital fat and dorsal lacrimal were the most consistent contributors to the increase. In contrast to the sodium-iodide and thyroxin experiments, the increase in the extraocular muscles was slight. In part, this may be due to the small number of animals used, but it does seem to indicate that muscles react more slowly to pituitary injections. This characteristic was noted in earlier studies (Smelser[8]).

Discussion

Injection of large amounts of either sodium iodide or diiodotyrosine does not affect the development of postthyroidectomy, anterior-pituitary exophthalmos. This finding is in agreement with the majority of reports of clinical cases treated with Lugol's or other iodide compounds, and is an additional indication of the similarity of this type of experimental exophthalmos with the clinical. In contrast with these results are those of Marine, Rosen, and Cipra,[9] who found that iodine administration prevented the development of exophthalmos resulting from cyanide injections in rabbits. Marine's experiments, conducted on young, normal animals, also showed that exophthalmos produced by cyanide injection did not occur if plant or fruit juices were given. These facts strongly suggest that the cyanide proptosis is not produced through the anterior-pituitary action, as Marine postulated, and is not comparable to clinical exophthalmos of the postthyroidectomy type.

No explanation is offered for the interesting and unexpected production of a transitory "stare" and slight proptosis by the injection of sodium iodide. The condition is possibly the result of toxic action of the large amount of iodide injected; therefore, comparable to the ocular symptoms produced by cyanide. Further investigation of this phenomenon must be made, but there is no indication that it affects the data presented here, for the eyes had returned to normal before the pituitary injections were started, and only about half the animals were affected in this manner.

In its effect on anterior-pituitary exophthalmos, thyroxin differed sharply from the other iodine compounds used. As demonstrated by the treated controls, thyroxin had a marked, direct effect on the orbital tissues. It seems probable that the enophthalmos produced is a result of the decreased orbital contents, which may be correlated with the weight loss in all parts of the body.

Pituitary extract clearly affects the orbital structures of hyperthyroid animals, for the retrobulbar tissue of the injected animals increased 25 percent over the thyroxin-treated controls, a proportional increase greater than in the diidotyrosine series. It is probably the direct action of thyroxin on the orbital structures that checks the exophthalmos.

These experiments also contrast sharply with those of Marine, Rosen, and Cipra[9] on methyl-cyanide exophthalmos in rabbits. They found that thyroid feeding did not decrease the exophthalmos, but tended to enhance it.

The more marked effect of anterior-pituitary extracts on the eyes of thyroidectomized guinea pigs (Marine and Rosen,[10] Smelser[8, 11]) finds an explanation in the experiments reported here. Injection of these extracts into normal animals produces a hyperthyroidism, through its action on the thyroid, thus counteracting any exophthalmic tendency.

It has been established that the most extreme cases of exophthalmos are those associated with a normal or subnormal metabolic rate, and occurring after thyroidectomy and the subsidence of all hyperthyroid symptoms (Burch,[12] Naffziger,[13] Wheeler,[14] Thomas and Woods[7]). This picture is duplicated in the present experiments, in which the more marked exophthalmos associated with orbital modification occurred in the hypothyroid animals.

There were indications that the exophthalmos produced in the hyperthyroid (thyroxin injected) animals was somewhat different from that developed in the control (iodide or diiodotyrosine and pituitary-injected) animals. The variation in degree and the early appearance of the proptosis suggested a functional factor. The possibility that the mechanism of exophthalmos in hypothyroidism and hyperthyroidism differs presents an intriguing problem for future study.

Correlation of experimental studies with clinical problems must be accompanied by great caution. Even though thyroxin injections seem partially to control experimental exophthalmos, similar results need not obtain clinically. Thyroxin was given in mass doses, body-weight loss was great, mortality high, and the administration was started before the slightest indication of a proptosis. The anterior-pituitary factors causing the exophthalmos were held at a minimum, thus giving marked advantage to the thyroxin action. Even under these extreme conditions results varied. Of the pituitary-treated hyperthyroid animals, 52 percent became somewhat exophthalmic. Furthermore, a longstanding case of exophthalmos in which the orbits probably contain much new-formed connective tissue might not react as do the experimental cases.

In interpreting these results it must be borne in mind that the exophthalmos was produced by a pituitary principle administered parenterally, whereas clinically, if an analogy may be drawn, the factors causing exophthalmos presumably are produced in the body. It is possible that the production or release of such a hypothetical factor could be influenced by thyroxin or other iodine compounds, thus realizing a more effective action than is suggested by these experiments.

Summary

1. Injections of large amounts of sodium iodide produce a slight transitory proptosis and widened palpebral fissure.

2. Sodium iodide reduced the weight of the orbital content, through its action on the dorsal lacrimal.

3. Exophthalmos produced by injection of anterior-pituitary extract is unaffected by coincident administration of sodium iodide.

4. Diiodotyrosine does not affect the orbital content nor the development of anterior-pituitary exophthalmos.

5. Thyroxin injections produce a marked enophthalmos and ptosis.

6. The orbital content of thyroxin-injected animals is markedly reduced. All of the tissues are involved in the weight loss.

7. Thyroxin injections reduced the incidence of anterior pituitary exophthalmos from 86 percent to 52 percent.

8. Anterior-pituitary extract increased the weight of the retrobulbar tissue of thyroxin-injected animals, though not above that of uninjected controls.

9. Exophthalmos can be produced in hyperthyroid guinea pigs, but in less degree than in hypothyroid animals.

10. These experiments substantiate previous evidence of the similarity of experimental anterior-pituitary exophthalmos and clinical progressive exophthalmos.

I wish to express my appreciation to Miss Victoria Ozanics for her assistance throughout this study.

References

[1] Thompson, W. O., and Thompson, P. K. Arch. Int. Med., 1931, v. 48, p. 351.
[2] Haines, S. F. Endocrinology, 1928, v. 12, p. 55.
[3] Wahlberg, J. Finska Läk.-sällsk. Handl., 1936, v. 79, p. 579.
[4] Ruedemann, A. D. Cleveland Clin. Quart., 1937, v. 4, p. 66.
[5] Rynearson, E. H. Proc. Staff. Meeting Mayo Clinic, 1936, v. 11, p. 321.
[6] Zimmerman, L. M. Amer. Jour. Med. Sci., 1929, v. 178, p. 92.
[7] Thomas, H. M., and Woods, A. C. Johns Hopkins Hosp. Bull., 1936, v. 59, p. 99.
[8] Smelser, G. K. Amer. Jour. Ophth., 1937, v. 20, p. 1189.
[9] Marine, D., Rosen, S. H., and Cipra, A. Proc. Soc. Exp. Biol. and Med., 1933, v. 30, p. 649.
[10] Marine, D., and Rosen, S. H. Amer. Jour. Med. Sci., 1934, v. 188, p. 565.
[11] Smelser, G. K. Proc. Soc. Exp. Biol. and Med., 1936, v. 35, p. 128.
[12] Burch, F. E. Minn. Med., 1929, v. 12, p. 668.
[13] Naffziger, H. C. Arch. of Ophth., 1933, v. 9, p. 1.
[14] Wheeler, J. M. Amer. Jour. Ophth., 1934, v. 17, p. 683.

Discussion

Dr. Lemoine: What portion of the pituitary was used, and what effect does anterior pituitary have on orbital contents?

Dr. Smelser: I am afraid I omitted many significant points in this discussion; however, the extracts which were used were prepared according to a method described a year ago and contain many of the physiologically active principles of the anterior lobe of the pituitary. They contain a thyrotropic substance and they cause the increase in orbital contents that I have described to you and which I reviewed at the early part of the discussion. The changes are mostly increase in connective tissue and water.

Dr. William L. Benedict: Is the increase in orbital content due to tissue hypertrophy or to increased fluid content, and in what proportion?

I think that question should be elucidated a bit, because there is one explanation for the exophthalmos which presumes increase in tissue by hypertrophy; another explanation is that the actual increase in volume is primarily fluid.

Dr. Smelser: I suppose I should be glad that many questions are asked which I really cannot answer, and I cannot answer that question as it deserves.

The increase in tissue, as I have used the expression, means increase in the mass of material which I weighed, orbital fat, connective tissue, and cellular material of various sorts.

There is, in addition, a large amount of edematous material which can be seen on staining and in sections.

I am not quite ready to report conclusively on the changes in the water content as measured quantitatively. As has been suggested, however, preliminary data which I do have indicate that the muscle and the fat have a greater proportion of water in them than normal.

LECTURES ON MOTOR ANOMALIES

III. The signs and symptoms of heterophoria*

A. Bielschowsky, M.D.
Hanover, New Hampshire

If the ophthalmologist is thoroughly familiar with the physiology of the sensorial and motor apparatus of the eyes, he can dispense with complicated and expensive instruments—a few simple methods will be sufficient for the investigation of heterophoria. To ascertain a possibly anomalous position of rest, the chief object of the tests is to eliminate the fusion tendency as much as possible. After the visual acuity and the refraction have been examined in order to find out whether either eye possesses foveal fixation and whether there is any ametropia which might possibly influence the position of the eyes relative to each other, one should always begin the investigation of the motor apparatus with objective tests. First the patient is asked to turn his eyes as far as possible in the different lateral, vertical, and oblique directions in order to find out roughly whether the movements of the eyes are equal or unequal, or restricted in one direction or another. Then he must look straight forward at a light five, or at least two, meters distant, situated in the center of the Maddox tangent scale, at the level of his eyes. Notwithstanding both visual lines being directed to the fixated light, the corneal reflex will be seen, as a rule, to lie not exactly in the center but in a peripheral part of the cornea, or the pupil; in other words, the visual line connecting the fovea with the fixated light, does not coincide with the antero-posterior (geometrical) axis of the eye. The angle formed by these two lines, known as the angle γ, is called positive (fig. 10) or negative (fig. 11) according to whether the visual line passes through the nasal or the temporal part of the cornea. A positive angle is met with much more frequently than a negative angle γ which occurs especially in cases of myopia of a high degree. Since the angle may amount to 7 or 8 degrees in either eye—as a rule it is greater in one eye than in the other—persons with orthophoria may show an apparent divergent or convergent squint. On the other hand, an actual convergent strabismus may be hidden by a positive angle γ, whereas a divergent squint may be either over- or underestimated in cases with a positive or negative angle γ, respectively. In very rare instances a vertical angle γ has been

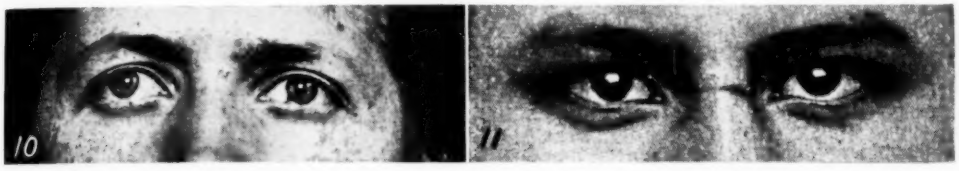


Fig. 10 (Bielschowsky). Positive angle gamma. The position of the geometrical axes of the eyes create the impression of a divergent squint while the visual lines are perfectly parallel.
Fig. 11 (Bielschowsky). Negative angle gamma. The position of the geometrical axes of the eyes create the impression of a slight convergent squint while the visual lines are parallel.

* From The Dartmouth Eye Institute, Dartmouth Medical School. Read before the Seventh Annual Mid-Winter Clinical Course of the Research Study Club, Los Angeles, California, January, 1938.

found, the visual line passing through a point either above or below the corneal center. The angle γ is to be measured either on the perimeter, by moving a light along the perimeter arc until the reflex is seen lying in the center of the pupil while the eye is looking at the zero point of the arc; or the patient is asked to look at the numbers on the tangent scale. The number at which he is looking when the corneal reflex of the light in the center of the scale appears in the center of the pupil indicates the amount of the angle γ.

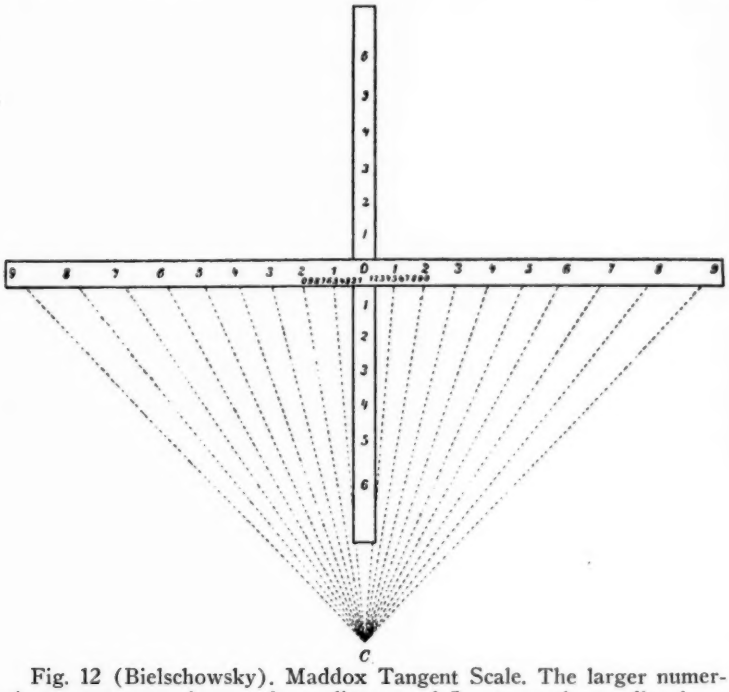


Fig. 12 (Bielschowsky). Maddox Tangent Scale. The larger numerals represent arc degrees for a distance of 5 meters; the smaller for a distance of 1 meter.

Binocular fixation is shown to be present if either eye keeps its position unaltered while the other is covered for just a second. But if the two eyes are covered alternately and repeatedly for *several* seconds, one eye immediately after the other, in most cases a slight movement of the uncovered eye, by which it achieves fixation, will demonstrate that its position behind the screen is different from that which it has while fixating; in other words, a muscular imbalance becomes manifest after the fusion tendency has been suspended. The kind and the amount of the deviation taking place behind the screen is to be determined by ascertaining in which direction, and how strong a prism has to be put in front of one eye in order to neutralize the movement which had taken place in the cover test. A more exact measurement of the latent deviation will, of course, be obtained only by means of the diplopia test. Primary and secondary deviations should be measured first for the primary, then for the different secondary directions of gaze.

Instead of moving the light fixated by the patient the doctor turns the patient's head so that he has to move the eyes in

the opposite direction in order to maintain fixation. Then the cover test is applied while the patient's head is tilted to the right and to the left around the sagittal axis, the eyes being directed straight forward. Finally, the test is repeated for symmetrical convergence at reading distance; furthermore, the near point of convergence must be determined. The passive rotation of the patient's head to induce the various ocular movements instead of shifting the light through the whole field of fixation has the advantage that the doctor is able to control the position of the patient's head and eyes during the whole examination. In many cases the doctor will already know from the results of these tests whether a simple or a complicated heterophoria exists, or a paresis of one or several muscles. But in any case the diplopia test, wherever it is applicable, must be made in order to get exact measurements of the deviation in the different parts of the field of fixation. The patient is fixating the little lamp in the center of the Maddox tangent scale (fig. 12). The big numbers of the scale indicate arc degrees if the scale is at a distance of 5 meters from the patient. The small numbers indicate arc degrees at a distance of 1 meter. If the angle of squint exceeds 10 degrees the test has to be made at a distance of 2.5 meters between patient and scale. In that case the distance between the center and number 5, for instance, would correspond to an angle of 10 degrees. If a vertical deviation were combined with a lateral deviation the red light would appear above or below the horizontal scale, being at the same level with one of the figures of the vertical scale indicating the amount of the vertical deviation. The patient has a dark-red glass in front of one eye. If the vision of the eyes is not equal the red glass must be put before the better eye in order to prevent a supression of the image of the weaker eye. The red glass must be so dark that the eye behind it does not see anything but the red light. (Otherwise the patient would see double images of the whole tangent scale and would be unable to make exact statements as to the separation of the two lights.) The red light will appear in the same direction as the figure,

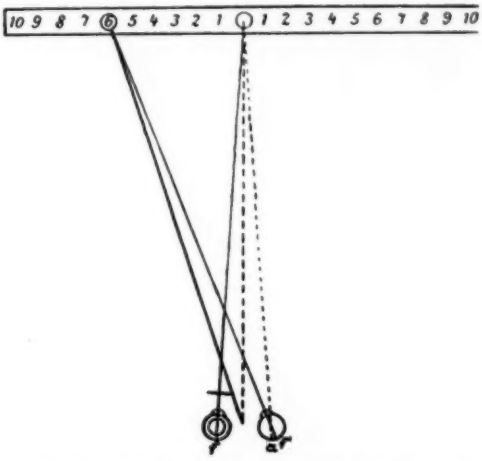


Fig. 13 (Bielschowsky). Double images in a case of paralytic convergent squint. The left eye is looking through a dark-red glass at the light in the center of the tangent scale. The red light formed on the left fovea appears coincident with the left number 6, the image of which lies on the right fovea, while the yellow light formed on an eccentric point (a) of the right retina is localized to the right of the red image. The distance between the double images subtends the angle of squint.

the image of which is formed on the fovea of the other eye (that is, on the spot corresponding to that bearing the image of the red light). If, for instance, while the left eye behind the red glass is fixating the light, the red image appears to cover the red number six on the left side of the scale in the center of which the bright light is seen, homonymous diplopia is recorded, corresponding to an esophoria or convergent strabismus of 6 degrees (arc), since the right visual line must be directed to this number. If

the patient has difficulty in becoming aware of the double images, be it because there is binocular single vision or because the red image is suppressed, a vertical prism of about 10^{Δ}, base up or down, may be added to the red glass. In the former case the red image will be seen on a number corresponding to half of the prism angle and in the direction of the apex. By turning the prism around its sagittal axis the red image will move correspondingly, which may do away with a possible suppression. As to the determination of a cyclophoria or torsion, as the meridian-declination is called, it can be done by means of the Maddox rod, unless there is spontaneous diplopia without the red glass, so that the patient can observe double images of contours; for instance, of the horizontal or of the vertical arm of the tangent scale. The double-image test is carried through in the same order as the objective determination of the deviation previously described: separation and direction of the double images relative to one another are tested first in the primary position of the head and of the eyes, and moreover, with the left eye as well as the right eye fixating. The double images must be tested in the whole field of fixation, by making use of the turning of the head, as was discussed before. The deviation occurring at *reading* distance after the elimination of the fusion tendency can be measured by the little apparatus which I have designed and called the "heterophorometer" (fig 14). A stereoscope frame is fitted with two prisms of 5 degrees each, base up before the left, base down before the right eye. In front of the left prism a red glass is inserted. The patient looks through the prisms at a cardboard situated at the end of the bar at reading distance. The drawing on the cardboard consists of a series of parallel red horizontal and vertical lines forming equal squares, the size of which corresponds to arc degrees calculated for the distance between the patient's eyes and the cardboard. In the center of the top line there is a green arrow. The red numbers on both sides of the arrow indicate arc degrees. The length of the arrow, as well as the distance between the top and the bottom line corresponds to an angle of 5 degrees. The patient will see the whole drawing, the red lines, the figures and the green arrow with the right eye, whereas the left eye, looking through the red glass, can see neither the red lines nor the figures because they do not contrast with the ground, which is likewise red. The left eye sees only the arrow, but it appears nearly black, due to the red glass. A person with perfect orthophoria will see the dark arrow exactly below the green one, the foot of the former being on the bottom line, the top touching the upper line and the foot of the green arrow, respectively. The diplopia is caused by the two vertical prisms of 5 degrees each, through which the patient is looking. In a case of exophoria the dark line will appear in the right half of the drawing, the number to which it points indicating the amount of the existing exophoria. If the top of the dark arrow does not touch the upper line but the next one below, a left hyperphoria of 1 degree is noted, as each square corresponds to an angle of 1 degree. If

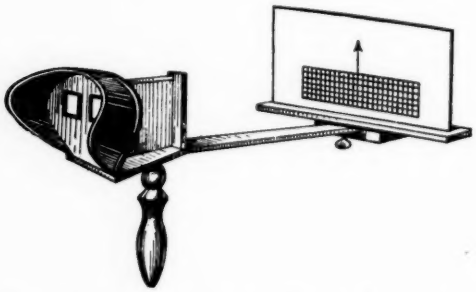


Fig. 14 (Bielschowsky). Heterophorometer. For testing heterophorias at reading distance.

the foot of the dark arrow is on the third line from the bottom instead of on the bottom line one will note 2 degrees of right hyperphoria. The cardboard must be brightly illuminated in order to make the dark arrow recognizable. If the visual acuity of the left eye is weaker than that of the right, the red glass must be put before the right eye and another drawing must be used in which the green arrow is drawn below the squares so that its top will touch the center of the bottom line. If glasses are required because of ametropia or presbyopia they can be fitted into the frame behind the prisms.

The last, but in many cases the most important test concerns the fusion power; that is, the range of the various fusion movements. They arise if the images of one outlying object formed on corresponding retinal areas are displaced by means of prisms or by the haploscope so that they are situated at disparate—that is, noncorresponding—points and would be seen as double images unless the fusion apparatus, acting similarly to a reflex mechanism, would change the position of the eyes so that the disparate images, brought back to corresponding areas, are fused. The range of the fusion movements, except the fusion convergence, is, as a rule, small, but the limits are not at all rigid, as they are said to be; they vary even in the same person if the power is tested at different times. If he is tired or feels ill he will display only a fraction or next to nothing of the amount of fusional amplitude that will be obtained if he is not fatigued. The fusion power is usually tested with the rotary prism, which produces according to its position, either a divergence or convergence, positive or negative vertical deviation. I speak of positive or negative vertical deviation according to whether the right visual line is turned upward or downward relative to the left visual line. One may dispense with the other terms, since the same innervation which produces right hyperphoria also produces left hypophoria. In testing right supravergence one will find exactly the same limit as in testing left infravergence, because in both cases the monocular movement is brought about by the same positive vertical divergence innervation. This is demonstrated by the fact that while wearing before the right eye the strongest prism, base down, which one is able to overcome by an upward movement of the right eye, one cannot overcome even the weakest prism in the reversed position before the other eye. And if one repeats the test in the reversed order with prisms of gradually increasing strength base up before the left eye, one will find exactly the same maximum of infravergence of the left eye which in the previous test was found as the maximum of right supravergence. So it does not make any difference whether in the vertical fusion power tests one may determine right supravergence or left infravergence and right infravergence or left supravergence. But to avoid errors the following facts must be considered: First, a single test is not sufficient to determine the range of a certain fusion innervation. If the test is immediately repeated several times in succession and the prism strength is increased very slowly it will be possible to tolerate stronger prisms in the later experiments without seeing double, till finally that prism will be found beyond which one cannot go without seeing double however often the experiment may be repeated. Second, if one tests the opposite kind of vertical divergence in the same way, without a long pause, he will get at best a small fraction, if any, of the amount that would have been obtained if this test had come first. But about the same amount will be obtained by repeating the latter test six or more times. It is evident

that one does not obtain the true range of any kind of fusion movements if only one test is made, especially if too soon after having tested the contrary fusion movement. Either the same test must be repeated about six times at short intervals until a constant amount of vertical deviation is obtained, or at least 15 minutes are allowed to elapse before the contrary kind of fusion movement is tested.

What was said about the antagonistic vertical divergence innervations holds good, other things being equal, for torsion movements; that is, the rotations of the eyes around the visual axes (in opposite directions), by which the parallelism of the corresponding retinal meridians is lost. The exact range of torsion movements, conclination and disclination, can be tested only with Hering's haploscope, in which two targets with identical prints are fitted. After they are fused in the primary position of the eyes, one of the targets is rotated very slowly around the sagittal axis. At first the horizontal lines will appear in double images crossing each other at acute angles in or near the fixated center of the lines; but they will be fused again after the rotation has been stopped for a moment and is then continued very slowly. Ultimately, the limit of rotation will be ascertained beyond which it is not possible to go without seeing double. If the test is repeated several times, one immediately after the other, the range of fusion will be found to be larger, until at last the limit becomes constant. The same maximum of torsion will be found if, without making a long pause, the second target is rotated in the opposite direction while the first target is in the zero position. The range of torsion, if tested by the haploscope, is much larger than it is usually supposed to be. Under normal conditions Hofmann and I[9] found it to be up to 20 degrees and more. A latent conclination or disclination, here usually called cyclophoria, of more than 2 degrees is met with very seldom in cases of true heterophoria. It plays an important part only as one of the paretic symptoms which will be discussed later.

The range of convergent and divergent fusion movements may likewise be determined by means of prisms, base in or base out, of gradually increasing strength, or with the haploscope, the arms of which can be brought into divergent or convergent positions. The divergence power in persons with orthophoria amounts to about as many degrees as the range of the vertical fusion movements, provided there is no exophoria or hyperphoria. The range of convergence is, of course, the largest among the fusion movements, since convergence, as a link of the mechanism for near vision, is governed by the will and, due to constant use, is exercised much more than the other fusion movements, the range of which will be found to enlarge about the same extent as the convergence, only in cases where either exo- or hyperphorias have existed from early childhood. Both convergence and divergence movements must be tested in a thorough examination for distance as well as for near.

I have discussed the fusion power and its examination rather fully because of its value for diagnostic as well as for therapeutic purposes. In cases of heterophoria showing the aforementioned fluctuations of the angle of latent deviation in the usual tests when repeated several times under different and even under apparently equal conditions, also frequently when using Marlow's prolonged occlusion test, a careful examination of the fusion power may supply the most approximate data for the existing anatomic position of rest. If the range of a certain fusion movement—for instance of positive vertical divergence—goes far beyond the average limits obtained by the same kind and the

same number of tests applied to normal individuals, whereas the range of the antagonistic movement in the negative vertical divergence is abnormally narrowed, it is fairly certain that there is an anomalous position of rest corresponding to the enlarged fusion movement; that is, a right hyperphoria, the amount of which, as a rule, is a little smaller than the limit of positive vertical divergence. The surplus corresponds approximately to the average extent of the range of positive vertical divergence in persons with orthophoria, so that in the chosen example of right hyperphoria the amount of vertical divergence produced by the prism test will contain the amount of the position of rest uncovered by the relaxation of the compensating fusion innervation (negative vertical divergence) plus the amount of active positive vertical divergence innervation caused by the prismatic vertical displacement of the retinal images after the eyes have arrived at their position of rest. If, after the repeated prism tests, the last prism which the patient is able to overcome by increasing the vertical divergence innervation is replaced by the dark-red glass, the vertical distance between the double images displaying right hyperphoria will decrease a little at first, and then remain relatively constant, frequently being considerably larger than in the former tests prior to the fusion-power test. There are, indeed, rare cases in which the fusion-power test fails to facilitate the determination of the position of rest because intermittent abnormal innervations continually influence the position of the eyes relative to each other, as was shown in the discussion of the so-called alternating hyperphoria. But the particular conditions in these cases can be recognized by the fusion tests in so far as the range of both the positive and the negative vertical divergence innervations is considerably enlarged. As to its therapeutic value, the fusion-power test shows that the limits of the range of fusion can be enlarged, and how far. It is the basis or starting point of the orthoptic training which plays an important part in the treatment of cases with a weakened fusion faculty and with such a small angle of deviation that operative procedures are not to be considered.

In cases of permanent squint and of muscular paralyses, other methods of investigation are necessary and will be discussed later on. The procedures hitherto described are sufficient for determining the kind and the amount of any heterophoria; frequently, also, whether it is caused by nervous or mechanical factors, or both. With this in mind I should like to emphasize once more that the cases under discussion must be examined, first of all, with the patient's eyes directed at a *distant* point, and that not only in the primary, but in all the secondary positions; apart from that the influence of an existing ametropia must be checked by comparing the findings with and without the correcting glasses. The results obtained by the tests for near, if compared with those for distant vision, will show whether and how far the existing troubles are caused by innervations employed solely or especially in near work. By fulfilling these requirements one cannot overlook a slight paresis or any other anomaly confined to a certain muscle or muscle group. This is important in regard to the question of treatment. In general it is granted that in heterophoria, as a latent concomitant squint, the angle of deviation does not depend, or only to an unimportant degree, on the direction of view in contrast to a typical paresis. A true exophoria or esophoria will not increase when the eyes are moved to the right or to the left, but as a rule, there will be a slight increase, or decrease, respectively, according to whether they move up or down. This is due to the

mechanical conditions which favor a divergent position of the eyes in elevation and a convergent position in depression.

Vertical deviations are quite often diagnosed incorrectly. There are at least four different types of these deviations, all of which may appear at first sight as simple hyperphorias kept latent by a strong fusion power. In cases of true hyperphorias the vertical deviation is about the same in the whole field of fixation, so that it cannot be attributed to an anomalous function of certain vertical muscles. The characteristics of the second group, the alternating hyperphoria, have been discussed before. Each eye when covered moves up, or one eye is deviated first upward then downward, while the position of the fixating eye remains unaltered. In the diplopia test a patient with a simple, that is, concomitant right hyperphoria will see the red image either below or above the other image, according to whether the red glass is in front of the right eye (which is deviated upward), or the left (which is deviated downward), whereas a patient with a typical alternating hyperphoria will always see the red image below the other one, regardless of whether the red glass is before the right eye or the left. In cases of the latter group the vertical deviation is more unsteady than in the former group because of the intermittent excitations of the vertical divergence centers. Apart from that unsteadiness, changes of the direction of view, as a rule, have no more influence on the vertical deviation of the second group than they have on the first group. In a third group the vertical deviation will display more or less characteristic signs and symptoms of a paretic origin, particularly a *regular* increase or decrease, respectively, according to the position of the fixated object in different parts of the field of fixation. (The other characteristics of the different kinds of pareses will be discussed later on.) The cases belonging to the fourth group are frequently confused with the paretic group. While showing no hyperphoria whatever, or only a small amount in the primary position (of either eye), a striking upward deviation arises when looking to the left, or to the right (fig. 15). Instead of remaining in the same horizontal plane in which the right visual line moves out, the left one moves in and up, whereas in looking to the left, either both visual lines keep to the same level, or the right eye moves up and in (more or less than did the left eye in looking to the right). It seems that in such a case, one or both of the inferior oblique muscles being stronger than their antagonists, produce this vertical deviation, a behavior which can be observed in cases of trochlearis palsy with a considerable secondary contracture of the inferior oblique. That the anomaly in the cases under discussion is not caused by a trochlearis palsy must be inferred first from the fact that in many of those cases a vertical deviation is absent in the primary position of the eyes



Fig. 15 (Bielschowsky). a, Binocular fixation in the primary position of the eye. b, In levoversion the right eye deviates upward. c, In dextroversion the left eye deviates upward.

which never occurs in cases of paretic origin, and also from the fact that the angle of the vertical deviation does not increase or decrease when looking down, or up, but is influenced only by the lateral movements of the eyes. In all cases where the vertical deviation is absent in the primary position, the anomaly is very probably of congenital origin, due, perhaps, to an anomalous weakness or a deficiency of the check ligament, which under normal conditions restricts the function of the inferior oblique.

The subjective symptoms of the different kinds of heterophoria have been the subject of very extensive discussions. Apart from diplopia, which occurs temporarily in patients with a considerable latent deviation if they are tired or exhausted, many of them complain of pains in the eyes, headaches, premature fatigue while reading and writing, blurred vision, vertigo, nausea, digestive disturbances, and so on. Many other symptoms of a general or localized neurosis, for instance spasms of the facial and other muscles, even epilepsy, have been attributed to heterophoria. Its importance as an etiologic factor of serious neurological diseases, has been, I am sure, exaggerated. In regard to this question I have made very extensive and thorough investigations[10] of several hundred patients suffering from different kinds of so-called functional neuroses and epilepsy. By comparing the results obtained in such cases with those obtained in examinations of the same number of perfectly healthy people without any trouble, I was able to ascertain that the frequency and the amount of heterophoria in both groups were approximately equal, even a little less in the neurotic group. In consideration of this statement and of the fact that a small amount of heterophoria is a physiological condition and that many people with rather considerable amounts of phoria have no symptoms whatever, I am convinced that, as a rule, a neuropathic condition is not produced by slight amounts of heterophoria, but on the contrary, is the primary factor causing the aforementioned symptoms of heterophoria. The effort to maintain binocular single vision causes discomfort, rapidly arising fatigue, and the other symptoms of eyestrain in cases of *slight* heterophoria, only if the patient's general resistance is diminished due to a neuropathic condition or to a physical or psychical exhaustion. But, of course, that does not mean an undervaluation of the importance of ocular treatment in neuropathic patients with heterophoria, all the less since the prospects of curing the neuropathic condition—which is frequently of a hereditary nature—as a rule are not very great, whereas a removal or diminution of the ocular anomaly may, to a certain degree, have a favorable influence even on the general conditions. In cases showing a discrepancy between the intensity of the subjective troubles and the slight amount of heterophoria, a difference in the size and shape of the ocular images (aniseikonia) may be the real or main cause of the trouble, particularly if there is no ametropia of any importance, or if a careful correction of the refractive error has failed to relieve the patient of his troubles. The desired result has been achieved, in many cases, only after aniseikonia has been determined and corrected by adequate glasses. Frequently the prisms which the patients had worn previously without obtaining relief could be discarded without any symptoms being caused by the remaining heterophoria.

In cases of heterophoria, apart from directions concerning diet, mode of living, and so forth, several kinds of therapeutics must be considered: prism spectacles, exercises, and operations. First of all, any refractive error, particularly for

near vision, must of course be corrected. A possible decentration of the glasses being worn in a wrongly fitted frame must also be considered as a conceivable cause of a heterophoria, bearing in mind that when looking through a spherical lens of 5 D., for instance, 10 mm. from the center one will get a prismatic effect of about 5 prism degrees. This secondary effect of spherical lenses may occasionally be used in cases of ametropia combined with heterophoria in order to get cheaper and not too heavy glasses. Prism spectacles will be useful particularly in cases of slight hyperphorias, where exercises are of little value; they will sometimes give the patients immediate relief. Prisms of more than 3^{Δ} or 4^{Δ} are seldom prescribed, because many patients complain of the distortion of the retinal images caused by stronger prisms. However, there are patients who feel very comfortable with prisms up to 10^{Δ}. In the face of reports of cases in which latent deviations of less than 1^{Δ} were supposed to have caused severe subjective symptoms, I cannot help being skeptical, the more so if the author has neglected to state explicitly by what methods and how often the heterophoria was examined. The relief from subjective disorders obtained by prisms compensating for a deviation of one fourth or one half of an arc degree cannot be taken as irrefutable evidence of the decisive role played by a slight heterophoria as the origin of the subjective trouble. I have seen a number of patients wearing weak prisms prescribed elsewhere who were convinced of the immense service the prisms had rendered in removing severe symptoms. In some cases the patient assured me that his symptoms returned as soon as he took off his glasses. Pretending to examine the glasses while the attention of the patient, who had consulted me for a slight conjunctivitis or some other insignificant matter, was diverted by an assistant or a nurse, I rotated the prisms so that they increased the heterophoria instead of correcting it. When I asked the patient on his next visit whether he was still satisfied with his glasses, he replied in the affirmative. That prisms render the best of service and are even indispensable in many cases of heterophoria is well known. But, though I am willing to acknowledge that a comparatively slight amount of hyperphoria may be the cause of serious symptoms, since I have caused such trouble to disappear promptly with vertical prisms, I should not prescribe prisms of less than 1 degree for both eyes. If the amount of hyperphoria is really not higher than 1 degree I should look for another possible cause of the symptoms and failing to find any, I should prescribe prisms of one-half degree only if the amplitude of fusion in the vertical direction is practically zero and an improvement by orthoptic training cannot be obtained. But before giving prisms in any case of heterophoria, one must make sure that the prisms will correct the deviation at least in a considerable central part of the field of fixation. Apart from being useful in hyperphoria, a prismatic correction may also be of service in cases of true esophoria, particularly if combined with myopia or emmetropia, in which exercises for training the divergence innervation do not give the desired result.

I should warn against prescribing prisms, base out, unless an anomalous position of rest as the basis of esophoria has been substantiated by thorough and repeated examinations excluding, as far as possible, a nervous origin of the latent deviation. In esophoria of nervous origin the excessive convergence innervation would be maintained or even increased by adducting prisms. Convergence spasms are suggested by the unsteadiness of the deviation, but their source is not always easy to ascertain. Atropine should be

given for three successive days to young people in order to uncover a possible latent hyperopia which might be responsible for the esophoria. Frequently the prismatic compensation of a fraction of the esophoria will be sufficient, whereas in hyperphoria nearly the full correction with prisms can be given, provided that no more than 3^{Δ} or 4^{Δ} is required. In exophoria of a not too high degree convergence exercises with the phorometer or the haploscope or other orthoptic apparatus are preferable to prism spectacles, which increase the weakness of the convergence innervation. The prospect of succeeding with exercises in cases of exophoria is much better than in hyperphoria and in esophoria, since the physiologic amplitude of the convergence innervation is much larger than that of the other fusion innervations. Of course, the training must be continued for months, and even then one cannot always get a satisfactory improvement. It may be that the convergence insufficiency in such cases does not play the principal role. The question of when and how patients with heterophoria shall be operated on will be discussed, together with the operative treatment of squint.

References

[9] Hofmann, F. B., and Bielschowsky, A. Ueber die Willkür entzogenen Fusionsbewegungen der Augen. Pflügers Arch. f. d. ges. Physiol., 1900, v. 80, p. 1.

[10] Bielschowsky, A., and Ludwig, A. Das Wesen und die Bedeutung latenter Gleichgewichtsstörungen der Augen. Arch. f. Ophth., 1906, v. 62, p. 400.

STUDIES ON INCLUSION BLENNORRHEA*

III. Experimental considerations of the etiology

L. A. Julianelle, Ph.D., R. W. Harrison, Ph.D., and A. C. Lange, M.D.
Saint Louis

The observation which was confirmed and extended in this laboratory,[1] namely, that inclusion blennorrhea may be transmitted in a modified form to the monkey and ape,[2–12] furnished an appropriate, if not an ideal, animal for a study on the etiology of this disease. Granted that certain past observers, as will be brought out later, advocated the concept that the cytoplasmic inclusion associated with the epithelial cell is the actual infectious agent, other workers, on the contrary, entertained considerable scepticism of this relationship. Consequently, it was desirable to reopen the question of etiology and undertake pertinent experiments on a broad general basis, and possibly by the method of exclusion arrive at a more concrete visualization of the incitant. Accordingly, a number of experiments have been conducted towards this end, and, after five years of intermittent study, it seems a justifiable purpose to place on record the observations made.

Methods

The methods employed in this investigation are essentially those adopted in similar studies of trachoma, as already published in several communications.[13, 14] It will not be necessary, therefore, to give more than a brief recapitulation at the present time. Material for study was obtained from patients with inclusion blennorrhea by scraping the conjunctiva anesthetized with holocaine or pontocaine, and suspending the tissues in veal-infusion broth. Immediately after they had been collected, suspensions from the different patients were always studied separately. The tissues were triturated under sterile conditions with mortar and pestle without introduction of abrasive substances. The ground material was then utilized for the different experiments to be described later in the report.

The clinical diagnosis in each instance was verified by examination of stained smears from the scraped conjunctiva. Only those patients showing a generous scattering of inclusion bodies were reserved for study. In certain patients, repeated specimens were taken during the more acute stages, but the results of the experiments performed were considered of possible significance only so long as the material obtained was infectious for monkeys.

Experimental

In accordance with the proposed plan of eliminative procedure, the first approach to be made was a determination of the bacteria cultivable from the conjunctiva of patients. A similar series of cultures made concurrently from patients with trachoma, folliculosis, and miscellaneous conjunctivitides of uncertain etiology, as well as from normal individuals, served to act mutually as controls, the one for the other.

Bacteria cultivable from inclusion blennorrhea. As in a previous bacteriological study of trachoma,[15] material for culture was inoculated on rabbit-blood agar, horse-serum agar containing multiple sugars, and Noguchi's leptospira, semisolid agar. In a few cases, ascitic fluid con-

* From the Department of Bacteriology and Ophthalmology, Washington University School of Medicine. Conducted in the Oscar Johnson Institute of Ophthalmology and Otolaryngology, under a grant from the Commonwealth Fund of New York.

taining fresh rabbit kidney sealed with sterile vaseline was also used. It may be said, however, that rabbit-blood agar was found to possess all the virtues and advantages of the other media, with the result that it was used most frequently. Inoculations were made not only with the scraped tissues obtained as described above, but also with material removed by swab before scraping, thus collecting mainly the exudate. Incubation was carried out at both 37°C. and 30°C., in some cases up to periods of 5 days, and in a few instances anaerobic cultivation was also attempted. In this way, 10 patients were studied carefully, and after that only occasional cultures on rabbit-blood agar were made, more for purposes of orientation than to discover the variety of bacteria present.

No useful purpose would be served in describing the individual results in detail, since it was immediately obvious that the organisms cultivated were those usually associated with the conjunctiva and having for the most part no pathogenic significance. Thus, staphylococci were isolated in greatest frequency and numbers. Both the albus and aureus varieties were present, the former more often, and some of the strains were hemolytic. Running very close in frequency were the different diphtheroids, in general occurring simultaneously with the staphylococci. On one occasion, a hemolytic streptococcus was isolated, and on several plates, a small unidentified gram-negative rod producing a pink pigment was also isolated. This rod, however, proved to be nonpathogenic for any of the animals tested, so that is was considered of no great importance in the present study. On two cultivations, no bacteria grew at all. All patients, however, showed bacteria on culture at one time or another, consequently no particular emphasis is laid on the exceptional seedings when organisms appeared to be absent. In short, it became obvious that the bacteria cultivated were purely adventitious and that they belong, indeed, to the species occurring on the normal conjunctiva.

None of the organisms isolated from eyes affected with inclusion blennorrhea were inoculated into monkeys to determine their effect on the conjunctiva. This was being done at the time on a large scale with cultures from trachomatous eyes,[15] and since the bacteria isolated from both conditions were of the same category, there was little reason for unnecessarily repeating similar inoculations. In the case of the bacteria derived from trachoma, different strains of organisms common to both diseases, in addition to other species isolated from trachoma only, were introduced on the conjunctiva of the animals. As has already been reported, 116 cultures were inoculated into 56 monkeys, and none of the organisms were able to induce a follicular conjunctivitis.[15] That is why it was regarded as repetitious and uninformative to repeat inoculations with organisms already proved to be nonpathogenic by the experiments in the case of trachoma.

Consequently, there seemed to be no reasonable purpose in continuing a bacteriological study of inclusion blennorrhea. Just as the results of James,[10] Thygeson,[11] and even Lumbroso,[16] despite isolation from 5 of 14 patients of a small gram-negative rod of speculative interest to themselves, so the present data also indicate that the bacterial flora of inclusion blennorrhea is nonspecific and fortuitous. The study accordingly proceeded to the presence of a filterable agent in inclusion blennorrhea, and its possible causal relationship to the disease.

Filterability of the infectious agent. That the infectious agent of inclusion blennorrhea might be filterable was indicated for the first time by a single experiment performed by Botteri.[8] He showed

TABLE 1

COLLECTED DATA ON THE FILTERABILITY OF THE INFECTIOUS AGENT OF INCLUSION BLENNORRHEA

Observer	Date	System of Filtration	Animals Inoculated	Infectivity of		Comments
				Tissue	Filtrate	
Botteri[8]	1912	Berkefeld (Type not stated)	1 Baboon	Infectious	Infectious	Single experiment
Lindner[17]	1913	Berkefeld (Liliput)	4 Baboons	Infectious	Inactive	Four experiments
Gebb[18]	1914	Berkefeld (Type, "finest")	1 Man	Not tested	Infectious	Single experiment
Thygeson[11]	1934	Elford membrane (A.P.D.—0.7μ)	2 Men	Not tested	Infectious	Two experiments
Tilden and Gifford[12]	1936	Elford membrane (A.P.D.—0.46 & 0.62μ)	2 Baboons	Infectious	Infectious	Two experiments
Present report	1938	Berkefeld V, Elford membrane (A.P.D.—0.6 to 0.69μ)	18 M. rhesus	Infectious 6 experiments	Infectious 4 experiments	Ten experiments, details in text.

that both the original material from an infected infant, and its Berkefeld filtrate as well, induced the experimental disease in baboons. Lindner[17] subsequently studied filterability and failed in four experiments to induce infection in baboons following inoculation of material filtered through Berkefeld candles. On the other hand, filterability of the infectious agent was confirmed shortly after by Gebb[18] when he succeeded in transmitting a follicular conjunctivitis to a human volunteer by administration of a Berkefeld filtrate of tissues obtained from the spontaneous disease. The only other experiments on filtration were performed in recent years by Thygeson[11] and Tilden and Gifford.[12] The former introduced the use of the collodion membranes as devised by Elford,[19] and succeeded in transmitting specific infection to two adults (one of whom was himself) with bacteriologically sterile filtrates from membranes with an average pore diameter of 0.7μ. Repeating these experiments, Tilden and Gifford infected two baboons, one with a filtrate from a membrane measuring 0.46μ, and the other with a filtrate from a membrane measuring 0.62μ A.P.D. Thus, four of the five previous workers studying filtration of the infectious agent of inclusion blennorrhea procured evidence of its filterability in a collected total of six experiments, or in two more than those signifying loss of infectivity following filtration. The data bearing on these experiments are summarized in table 1.

In conducting filtrations in this laboratory, the procedure utilized was that adopted in a similar study of the virus of trachoma.[20, 21] Scraped tissues from individual patients suspended in veal-infusion broth were ground aseptically in a sterile mortar, and the ground suspension was centrifugated for 3 to 5 minutes at about 1,500 r.p.m. to remove the heavier particles. The supernatant fluid was then filtered under a pressure of about 20 cm. Hg, and in this way the filtration was always accomplished in a matter of minutes. The filtrates were seeded in blood-agar plates, and the integrity of the filters was tested with young broth cultures of *B. prodigiosus*. In all the experiments, the filtrates proved to be bacteriologically sterile, and *B. prodigiosus* was uniformly withheld by the different filters.

The filters used consisted mainly of collodion membranes, but on two occasions Berkefeld V candles were employed. The average pore size of the membranes varied from 0.6μ to 0.69μ. With the exception of one experiment, which was done with tissues derived from experimentally infected monkeys, the material was obtained from infants.

The results of all the experiments on filtration have been summarized in table 2. Analysis of the tabulated data reveals that a total of 10 experiments was conducted. In four, however, the original, unfiltered material was found to be noninfectious when inoculated into monkeys, so that the results of the corresponding filtrations are unpreceptive, and therefore need be considered no longer. In the remaining six experiments, five were performed with human tissues. In two, IB-11 (b) and IB-17, the scraped material when transferred directly from infant to animal induced specific infection. After the material was filtered through collodion membranes (0.65μ A.P.D.), however, the infectivity was lost or so diminished that the filtrate was incapable of infecting monkeys. In the three other experiments with human tissues (IB-15, 16, and 18), on the other hand, it was found that filtrates from collodion membranes (0.63μ to 0.65μ), as seen in experiments IB-15 and IB-16, as well as a filtrate from a Berkefeld V candle (IB-18), were still infectious. In the final experiment, MPF-1, material was scraped from the conjunctivae of five monkeys with clinically active infection, and this was pooled before the preparing for filtration. This supplied a sufficient quantity for filtration of the same material through both col-

TABLE 2

SUMMARY OF EXPERIMENTS ON FILTRATION CONDUCTED IN THIS LABORATORY

Experiment Number	Source of Material	System of Filtration	Infectivity of Tissues	
			Unfiltered	Filtered
IB-9	Infant	Elford membrane (A.P.D.—0.6μ)	Inactive in 4 monkeys	Inactive in 2 monkeys
IB-11(a)	Infant	Elford membrane (A.P.D.—0.65μ)	Inactive in 2 monkeys	Inactive in 2 monkeys
IB-11(b)	Infant	Elford membrane (A.P.D.—0.65μ)	Infectious in 2 of 2 monkeys	Inactive in 2 monkeys
IB-13	Infant	Elford membrane (A.P.D.—0.69μ)	Inactive in 3 monkeys	Inactive in 2 monkeys
IB-14	Infant	Elford membrane (A.P.D.—0.69μ)	Inactive in 2 monkeys	Inactive in 2 monkeys
IB-15	Infant	Elford membrane (A.P.D.—0.63μ)	Infectious in 2 of 4 monkeys	Infectious in 1 of 4 monkeys
IB-16	Infant	Elford membrane (A.P.D.—0.65μ)	Infectious in 4 of 4 monkeys	Infectious in 2 of 4 monkeys
IB-17	Infant	Elford membrane (A.P.D.—0.65μ)	Infectious in 3 of 3 monkeys	Inactive in 3 monkeys
IB-18	Infant	Berkefeld V	Infectious in 2 of 2 monkeys	Infectious in 1 of 2 monkeys
MPF-1	5 infected monkeys	Berkefeld V Elford membrane (A.P.D.—0.65μ)	Infectious in 2 of 3 monkeys	Both filtrates infectious in 1 of 3 monkeys

lodion and Berkefeld V filters. Both filtrates were subsequently found to be infectious, thus indicating that when the proper conditions are met, the agent is readily filterable irrespective of the variety of filter used.

If further analysis is made of the data on filtration, it will be noticed that in those experiments conducted with infectious tissues, both human and animal, 18 monkeys were inoculated and 15 were infected. In the corresponding inoculations made with filtrates of these tissues, it is seen that only 6 of 18 monkeys were infected. In other words, there appears to be a distinct difference in the degree of infectivity between unfiltered and filtered material, the former having a gradient of infectivity of 83 percent, as compared with a gradient of 33 percent for the latter. While it is possible that by an exaggerated coincidence the animals selected may have varied considerably in individual susceptibility and thus explain the discrepancy observed in the relative number of successful transmissions between the two groups, it seems more likely that the difference is due to a partial loss in the infectious agent during the process of filtration.

In any event, the conclusion is inevitable that the infectious agent of inclusion blennorrhea is able to pass both collodion membranes of an average pore diameter of at least 0.6μ and Berkefeld V filters. Consequently, in six experiments with infectious material, filtrates retained the property of infectivity present in original tissues in four. Thus, then, the present study affords confirmation of the results of both those who reported filterability, and even of those of Lindner, whose findings were in apparent opposition. What appears to be an inconsistency may be explained by several factors, but most important is the degree of variation in infectivity of the different tissues. The loss in activity suffered during filtration, as noted above, may be great enough in certain instances to carry the infectious agent beyond its limit of infectivity, while on other occasions the plentitude of infectious material in the original tissues permits filtrates to retain infective capacities in spite of a loss comparable to that in the first case.

By way of contrast, it is interesting to point out the marked quantitative difference between the filterability of the infectious agents of trachoma and that of inclusion blennorrhea. The statistical evidence from this laboratory indicates in the case of trachoma a filtering efficiency of 3 out of 23 trials, or 13 percent; while similar figures for inclusion blennorrhea, as stated above, disclose an efficiency of 5 out of 7 trials, or 71 percent. Thus, it is seen that when the same methods are employed by the same workers, filtration of the infectious agent in the case of inclusion blennorrhea is five to six times more effectual than it is in the case of trachoma. The possible significance of this observation will be discussed later in this paper.

Cultivability of the infectious agent in tissue culture. The exclusion of cultivable bacteria as associated in the evolution of inclusion blennorrhea has been demonstrated by the failure to cultivate any organisms which may be considered specific, and by the relatively high frequency of infection in bacteriologically free filtrates derived from active tissues. The inability, moreover, of the infectious agent present in certain filtrates to propagate in bacteriological media suggested that its cultivation be attempted in tissue cultures. The techniques employed for this purpose have been described in great detail in a communication reporting similar studies with the virus of trachoma.[22] In general,

however, scraped tissues from patients were obtained as free of surface contaminants as possible by thorough irrigation of the conjunctival sac, and subsequent washing of fragments of tissues through several changes of Tyrode's solution. This technique did not always remove the bacteria, but it did allow a sufficient number of tissues to develop in the absence of bacteria. A few cultures were also made of filtered material, which it is now known may both contain the infectious agent and still be free of microorganisms. Obviously, it was not possible to conduct as elaborate a system of experiments as that undertaken for trachoma, for patients with inclusion blennorrhea are considerably rarer, and the amount of material available from each patient it also less, since the conjunctiva is smaller. Nevertheless, sufficient experiments have been performed to justify the opinions to be reported.

Tissue cultures were inoculated with material from seven different patients, all of whom showed definite inclusions at the time of seeding. It was possible in most instances to make repeated cultures from the same patient; from one infant, in fact, four different seedings were performed. Both filtered and unfiltered materials were used, and the cultural methods employed consisted of minced chick embryo, minced rabbit testicle or kidney, plasma clot with normal human plasma or normal rabbit plasma seeded with conjunctival cells from the patient or with normal rabbit tissue impregnated with filtrates of the infected tissues. In addition, cultivation was also attempted in the fertile hen egg. Thus, five different methods were employed, and incubation was carried out at both 37° C. and 32° C. The tissue cultures, either singly or pooled, were subsequently inoculated into monkeys, and a careful microscopic study was made of smear preparations of all the cultures, and, in some instances, of sections stained by hematoxylin and eosin as well as by the Giemsa method.

There is no purpose to be gained by a prolonged, detailed account of the tissue cultures. The information obtained from these experiments was, first, neither inclusions nor their constituent elements were ever observed in smears or sections of the tissue cultures. Second, none of the tissues when inoculated into monkeys induced any reaction even remotely simulating experimental inclusion blennorrhea. The conclusion is inevitable, therefore, that the methods employed, at least, did not satisfy the requirements of the infectious agent for propagation. As in the case of the trachomatous virus, the conditions for growth appear to be too subtle for the methods of tissue culture now in general use. In other words, the virus of inclusion blennorrhea must be regarded as a fastidious agent difficult of multiplication outside of the susceptible animal body.

The interrelationship of inclusion blennorrhea and swimming-bath conjunctivitis. That inclusion blennorrhea is transmissible to the adult human conjunctiva has been obvious from the several reported examples of accidental transfer of infection from infant to mother. The first example was pointed out by Lindner.[23] The infection in the adult conjunctiva was essentially a follicular reaction, was accompanied by characteristic inclusions, and eventually became resorbed with no permanent changes. In the same report, Lindner cites another example of passage from infant to an older sister, with more or less the same clinical evolution. A third individual infected his conjunctiva from a nongonorrheal, nonspecific urethritis, and in a fourth instance, a physician was infected (?) during an abdominal op-

TABLE 3

COLLECTED DATA ON TRANSMISSION OF INCLUSION BLENNORRHEA TO ADULT, HUMAN CONJUNCTIVA

Observer	Date	Inoculation	Incubation	Character of Lesion	Inclusions	Comment
Wolfrum[25]	1910	Planned, 2 volunteers	7 & 8 days	Follicular	Present	Diagnosed trachoma
Lindner[23]	1911	Accidental, child to mother, child to sister, from urethritis to eye	? ? ?	Follicular Follicular Follicular	Present Present Present	A fourth instance, not so clear, of trachoma; see text.
Noguchi and Cohen[24]	1911	Accidental, child to mother	2 to 3 weeks?	Follicular	Present	
Gebb[18]	1914	Planned, 10 volunteers	3 to 6 days	No reaction in 2, follicular in 8	Present	2 other inoculations 1 with heated material 1 with filtrate (see text)
James[10]	1930	Accidental, child to mother	Not stated	"Typical inclusion blennorrhea"	Present	Presumably papillary reaction
Taboriski[26]	1930	2 self-inoculations	No reaction once; then 12 days	Follicular	Present	
Thygeson[11]	1934	Planned, 2 volunteers. Accidental, child to mother	7, 7, and 8 days	Swimming-bath conjunctivitis	Present	2 other inoculations with filtrates (see text)
Thygeson and Mengert[27]	1936	Accidental, patient to physician	8 days	Swimming-bath conjunctivitis	Present	Inoculation from genital tract
Present report	1938	Accidental, child to nurse	5 days	Swimming-bath conjunctivitis	Present	Details in text

eration, acquiring typical trachoma with formation of a pannus. In the light of our present knowledge, the first three examples appear to be genuine inclusion infections, but the fourth case arouses a natural scepticism regarding acquisition of trachoma from the abdomen. Noguchi and Cohen,[24] James,[10] and Thygeson[11] subsequently reported similar occurrences of infection from child to mother. Another variety of accidental transfer of infection may be visualized from the instance reported by Thygeson and Mengert.[27] This was the case of a gynecologist who was infected with uterine material while performing a curettage.

In addition to the accidentally transmitted infections, several deliberate inoculations have been made from infected infant to the adult in an effort to elucidate the nature and character of the disease. In order to organize comprehensively the nature of the infections accidentally acquired or experimentally induced, a summary of the collected literature on this interesting subject is presented in tabular form (table 3).

Deliberate experiments to determine the relation of inclusion blennorrhea to trachoma were first carried out by Wolfrum.[25] Two individuals inoculated with material from infected infants showed

predominantly follicular reaction of the conjunctiva 7 and 8 days following the inoculation. Wolfrum concluded that he had succeeded in transmitting trachoma by this means and that therefore inclusion blennorrhea and trachoma were identical. The description of the condition accompanying the inoculation is given only superficially, and it is difficult to determine whether Wolfrum was justified in the diagnosis of trachoma. Apparently he was unnecessarily influenced by the demonstration of inclusion bodies in the conjunctival cells of the inoculated individual, and by his conviction that the inclusion is the causative agent of trachoma, disregarding the possibility that the resemblance of microscopical structures need not imply identity. Gebb[18] later repeated this experiment by inoculating 10 individuals, 7 with materials direct from infants, and 5 of these were infected. The remaining 3 volunteers were inoculated with material from 2 of the 5 experimentally infected volunteers. The incubation varied from 3 to 6 days, and in those infected, the conjunctivitis was follicular and showed inclusions, but in the author's judgment the condition was not trachoma, as, indeed, the clinical descriptions amply demonstrate. Taboriski inoculated himself twice,[26] the first attempt causing little effect, but the second inducing, after 12 days, a folliculosis, also characterized by inclusion bodies. Taboriski did not feel that the self-inflicted infection could be called trachoma, since the conjunctivitis disappeared within several weeks without complications or permanent injury.

In 1934, Thygeson[11] observed experimentally induced infection in several adults. In two volunteers, filtrates of human tissues were inoculated, with the development of infection as described above. In two other individuals, unaltered material from infected infants was inoculated, and after one week a reaction appeared which he designated as swimming-bath conjunctivitis. The mother infected by way of her child, as described above, also exhibited a conjunctivitis of typical swimming-bath variety. In each instance, inclusion bodies had been demonstrated as an essential feature of the conjunctivitis. He accordingly expressed his opinion that inclusion blennorrhea represents the infantile conjunctival response, and swimming-bath conjunctivitis the adult conjunctival response to the same agent. In fact, upon restudy and reconsideration of the descriptions published by the different observers, there can be no doubt that, in each case cited, the experimental or accidental infection may very well have been swimming-bath conjunctivitis, because of its parallelism to the course of the latter manifestation. It is more than probable that a diagnosis of swimming-bath conjunctivitis did not occur to the earlier observers, because knowledge of this disease at the time of the experiments had yet to be broadcast, and it was scanty as well. While this manifestation had undoubtedly been described in scattered communications before, it was Fehr[28] who consolidated the known information and applied the name "bath conjunctivitis." It was not until 1913, however, that Huntemüller and Paderstein[29] first described inclusions in this infection and thus brought swimming-bath conjunctivitis into the class of inclusion conjunctivitides.

Because of the relationship between the two manifestations of the one virus, it may not be amiss to designate the essential features of swimming-bath conjunctivitis. Not necessarily confined to individuals using swimming pools, the disease appears following a period of incubation of approximately a week, and it may last for several months. It may be associated with an upper respiratory disturbance and usually includes involvement of the pre-

auricular glands as noted by swelling and tenderness. Conjunctivally it may be follicular or papillary, and particularly in monocular instances accompanied by ptosis. The lower lids are usually more involved, and unilateral infection is not uncommon. Tendency toward recurrence after apparent healing is common, so that in one exceptional individual under observation, the condition kept reappearing over a period of 10 years. Secretion is usually a minor symptom, which, however, may cause blurring of vision. There is photophobia and only rarely a pruritis. Less severe in the adult, the condition is differentiated from trachoma by (1) greater reaction of lower lid, (2) more frequent monocular occurrence, (3) more frequent preauricular adenopathy, (4) lack of cicatrization, and (5) absence of corneal complication.

During this study, the occasion was presented to observe an accidental transmission similar to that of Thygeson. While she was irrigating the eyes of an infant on the seventh day since the onset of inclusion blennorrhea, pus was discharged into the left eye of the attending nurse. The nurse's eye was immediately washed with boric acid and protargol was instilled. Two days later, the conjunctiva of the left eye was moderately congested and there was a slight exudate. Cold compresses and 0.5-percent optochin were prescribed, and a diagnosis of acute conjunctivitis was made. On the fifth day following the accidental transfer, the nurse consulted with one of the writers. Examination revealed marked discharge, chemosis of the lower and upper retrotarsal folds, with small follicles, pinhead in size. There was definite ptosis, but the cornea was normal. Scrape smears were made at that time, and inclusion bodies were readily found. A similar examination of the infant also revealed numerous inclusions. The condition of the nurse rapidly increased in intensity; following two scrapings of the lids, exudation decreased, however, and there was definite improvement, so that by the end of a month, the eye had attained almost its normal appearance. Three weeks later, there was a sudden recrudescense with recurrence of ptosis, purulent discharge, and the reappearance of follicles. The condition endured for 7 days, when it spontaneously disappeared. Since that time the patient has been well and has suffered no further exacerbation. Throughout the period of observation, the infection remained localized in the left eye, and palpation failed to detect enlargement of the preauricular glands on the side of the infection. A diagnosis of swimming-bath conjunctivitis obviously fits the clinical condition described, so that the observation is considered a confirmation of Thygeson's conclusion stated above.

It is of interest to add that material from the nurse's infected eye was infectious for monkeys (*M. rhesus*), both unfiltered and when filtered through a collodion membrane of an average porosity of 0.6μ. The infection in monkeys was in every way similar to that stimulated by material derived from infants with inclusion blennorrhea. That swimming-bath conjunctivitis is also transmissible to monkeys was demonstrated in 1913 by Huntemüller and Paderstein.[29]

Relation of the infectious agent to the inclusion body. Considerable effort has been devoted in the past to determine the identity of the infectious agent of inclusion blennorrhea in respect to the epithelial cell inclusion accompanying the disease. In earlier studies, particularly, conclusions arrived at more by philosophical exposition than by convincing experimentation portrayed the inclusion equally well as incitant, cellular products of degeneration, or even bacteria modified

as a result of phagocytosis. With the introduction of improved methods, studies were undertaken more directly, but in many instances with the obviously transparent purpose of proving or disproving an interrelationship between the two factors. It was Thygeson,[11] however, who approached the subject on a broader basis, and, after eliminating other possibilities by experimentation, concluded that the elementary body is the infectious agent of inclusion blennorrhea. It seems, therefore, to be a useful service to appraise the evidence both in favor of and in opposition to this concept.

The studies attempting to prove that the inclusion constitutes degraded bacteria in the stage of phagocytosis may be dismissed as no longer tenable logically. The diseases exhibiting inclusions are few despite numerous other clinically simulating conditions. Consequently, it defies explanation why in these special instances the epithelial cell becomes so actively and exclusively phagocytic when normally and more actively phagocytic cells are present in great numbers. There can be no doubt that the inclusion is a specific function of the epithelial cell and that the cytoplasmic transformation is stimulated by special conditions operative in inclusion diseases alone. Phagocytosis does not destroy bacteria, yet the inclusions are not cultivable either on various bacteriological media or even by the more delicate method of tissue culture. The "bacteria," therefore, in the inclusion are noncultivable, and unrecoverable even by animal inoculation.

The frequency of inclusions in inclusion blennorrhea has been commented on by all workers. It was our experience also that inclusion bodies occur in large numbers in all early cases of the infection, so that their presence is diagnostic. There is, moreover, a general parallelism between the severity of infection and number of inclusions, and as the infection subsides, so the inclusions disappear; with recrudescence of symptoms there is a corresponding reappearance of inclusions. Consequently, regardless of its nature and significance, the inclusion body is the most valuable of the known diagnostic criteria.

Previous observers have all found inclusions in the accidentally or deliberately infected adult, as indicated in table 3. In the patient reported here, in fact, the presence of inclusions was the first tangible evidence of the specificity of the infection, since at that time the clinical signs were indefinite and a diagnosis of acute conjunctivitis only was possible. In infected animals, our predecessors have had remarkable success in demonstrating inclusion bodies. In fact, Heymann[5] found them even in the vagina of a conjunctivally infected monkey. How accurate some of the observations are to be considered remains conjectural, because certain authors found them in animals without a trace of infection. Our own results indicate that inclusion bodies were found in only 2 of 31 infected monkeys. It may be, as Thygeson states,[11] however, that the species *Macacus rhesus* is a poor animal for the development of inclusions. In any event, it is well known that viruses multiplying in a strange host may not be accompanied by their respective inclusions (for example, rabies, smallpox, and so on).

The most valid evidence as to the importance of the inclusion is its presence in animals and adults infected with filtered material, particularly as demonstrated by Thygeson[11] and Tilden and Gifford.[12] With membranes indicating the size of the virus to be less than 0.7μ A.P.D., Thygeson obtained filtrate containing elementary bodies demonstrable by staining methods. Following inoculation in humans, infection was induced

and inclusions were present in the conjunctival cells. With a membrane of only 0.43μ A.P.D., less than twice the size of the elementary body (0.25μ), the latter workers obtained an active filtrate and demonstrated inclusions in the infected baboon.

There can be little doubt that the inclusion is an actual phase of the infection. This does not supply conclusive proof, however, that the inclusion and the infectious agent are one and the same. That the inclusion may in turn represent an intracellular product of reaction or degeneration is still a possible explanation. The heterogeneous, organismlike structure of the inclusion suggests more logically that the inclusion is not a degenerative change. Thus, then, the question resolves itself into a suggestive but not proved position. The identity of virus and inclusion, however, is not so much a problem of inclusion blennorrhea as one of viruses in general. Here the question is interminable, still awaiting a conclusive answer, which is being rapidly supplied, in certain instances, at least, by the convincing studies of Woodruff and Goodpasture,[30] Barnard and Elford,[31] Ledingham,[32] Parker and Rivers,[33] and others.

Discussion

The studies on the etiology of inclusion blennorrhea conducted in this laboratory have been undertaken on a broad basis, the possibilities for consideration being restricted as experimental evidence dictated. Accordingly, an analysis of the bacteria cultivated from patients with this infection was undertaken first. The results indicated flora neither characteristic nor differentiable from that of normal eyes. None of the organisms, as determined in a previous investigation, were capable of inducing a follicular conjunctivitis, so that they were excluded from further consideration.

A study of filterability revealed the infectious agent to be filterable, but to lose a certain degree of infectivity during the process of filtration. Apparently capable of permeating both kieselguhr and collodion filters, the agent is freed of accompanying bacteria and induces in monkeys the typical experimental disease. Whether the virus is a phase of the inclusion body accompanying it in infection, still demands conclusive proof, as discussed above, although the evidence is suggestive that it may be the elementary body.

The infectious agent is characterized further by a high tissue selectivity, so that attempts at artificial propagation even in the presence of tissue cultures were failures. In some of the tissue cultures, infected conjunctival cells containing inclusions from the patient were cultivated *in vitro,* but this was not sufficient to support growth of the virus or to permit inclusions to form in the epithelial cells undergoing growth.

The number of similarities suggested between the virus of inclusion blennorrhea and trachoma raised a natural question as to their identity. This has been answered by the experimental infection in adults. The evidence is conclusive in that the virus of inclusion blennorrhea stimulates in the adult, not trachoma, but swimming-bath conjunctivitis.

Summary and conclusions

1. The bacteria cultivable by a variety of methods from inclusion blennorrhea are representative of the flora associated with the normal conjunctiva.

2. The bacteria so derived are nonpathogenic and they are incapable of inducing experimental inclusion blennorrhea in the monkey.

3. The infectious agent of inclusion

blennorrhea passes through Berkefeld V filters and collodion membranes of 0.6μ A.P.D.

4. Such filtrates are bacteriologically sterile and induce experimental infection.

5. Attempts to cultivate the infectious agent in tissue cultures were not successful.

6. Such tissue cultures were not infectious for monkeys and they did not contain inclusions.

7. The interrelationships of the virus and the inclusion are discussed.

References

[1] Julianelle, L. A., Harrison, R. W., and Lange, A. C. Amer. Jour. Ophth., in press.
[2] Lindner, K. Wien. klin. Woch., 1909, v. 22, p. 1555.
[3] Flemming. Arch. f. Augenh., 1910, v. 66, p. 63.
[4] Fritsch, H., Hofstätter, A., and Lindner, K. Arch. f. Ophth., 1910, v. 76, p. 547.
[5] Heymann, B. Klin. M. f. Augenh., 1911, v. 49, p. 417.
[6] Morax, V., Lindner, K., and Bollack. Ann. d'Ocul., 1911, v. 145, p. 321.
[7] Boeing, W. Arb. k. Gsndhtsamte, 1912, v. 40, p. 235.
[8] Botteri, A. Klin. M. f. Augenh., 1912, v. 50, p. 653.
[9] Löhlein, W. Arch. Augenh., 1912, v. 70, p. 392.
[10] James, W. M. Amer. Jour. Ophth., 1930, v. 13, p. 1084.
[11] Thygeson, P. Amer. Jour. Ophth., 1934, v. 17, p. 1019.
[12] Tilden, E. B., and Gifford, S. R. Arch. of Ophth., 1936, v. 16, p. 51.
[13] Julianelle, L. A., and Harrison, R. W. Amer. Jour. Ophth., 1933, v. 16, p. 857; also 1934, v. 17, p. 1035.
[14] Julianelle, L. A., Harrison, R. W., and Morris, M. C. Jour. Exp. Med., 1937, v. 65, p. 735.
[15] Harrison, R. W., and Julianelle, L. A. Amer. Jour. Ophth., 1936, v. 19, p. 118.
[16] Lumbroso, U. Arch. Inst. Pasteur Tunis, 1933, v. 22, p. 513.
[17] Lindner, K. Arch. f. Ophth., 1913, v. 84, p. 1.
[18] Gebb, H. Zeit. f. Augenh., 1914, v. 31, p. 475.
[19] Elford, W. J. Jour. Path. and Bact., 1931, v. 34, p. 505.
[20] Julianelle, L. A., and Harrison, R. W. Amer. Jour. Ophth., 1935, v. 18, p. 133.
[21] Julianelle, L. A., Morris, M. C., and Harrison, R. W. Amer. Jour. Ophth., 1937, v. 20, p. 891.
[22] Harrison, R. W., and Julianelle, L. A. Amer. Jour. Ophth., 1937, v. 20, p. 360.
[23] Lindner, K. Arch. f. Ophth., 1911, v. 78, p. 345.
[24] Noguchi, H., and Cohen, M. Arch. of Ophth., 1911, v. 40, p. 1.
[25] Wolfrum, M. Klin. M. f. Augenh., 1910, v. 48, p. 285.
[26] Taboriski, J. Arch. f. Ophth., 1930, v. 124, p. 455.
[27] Thygeson, P., and Mengert, W. F. Arch. of Ophth., 1936, v. 15, p. 377.
[28] Fehr. Berl. klin. Woch., 1900, v. 37, p. 10.
[29] Huntemüller and Paderstein. Deutsch. med. Woch., 1913, v. 36, p. 63.
[30] Woodruff, C. E., and Goodpasture, E. W. Amer. Jour. Path., 1929, v. 5, p. 1.
[31] Barnard, J. E., and Elford, W. J. Proc. Royal Soc. London, Series B, 1931-32, v. 109, p. 360.
[32] Ledingham, J. C. G. Lancet, 1931, v. 2, p. 525.
[33] Parker, R. T., and Rivers, T. M. Jour. Exp. Med., 1936, v. 64, p. 439.

THE HISTOPATHOLOGY OF PAPILLEDEMA*

BERNARD SAMUELS, M.D.
New York

In 1911 Paton and Holmes** made a careful and accurate study of the histology of papilledema in 60 globes removed from 39 individuals. In recent years it appears that no study of this subject, on such a large and painstaking scale, has been reported. Therefore it would seem not inopportune to report the findings in a rich material of 50 globes, removed from 47 individuals, making use of the information already imparted by others as the substratum of this paper. My chief purport is to present the anatomy of papilledema in such a manner as to enable the clinician to see more details and to interpret them more understandingly than he might otherwise do. At the same time it is hoped that he who knows the anatomy may profit by reviewing it and perhaps learn to know it still better.

In the course of this paper it is planned to dwell particularly on the presence of a peculiar tissue formation encircling many neurotic swellings that seems to have escaped the emphasis it deserves.

MATERIAL

The 50 globes were all removed after death and were assembled under the diagnosis of papilledema. They came from the collections of the New York Eye and Ear Infirmary and of Prof. Adalbert Fuchs of Vienna. In each case a diagnosis of papilledema was arrived at during life. The term papilledema, sanctioned by habit and familiarity, is here adopted because clinically each papilla presented a typical swelling of "choked disc" as the outstanding feature. Evidences of inflammation, such as opacities in the vitreous or of infiltration of the retina were not observed.

ETIOLOGY

In the 31 cases in which the etiology was available, a great variety of causes was represented; namely, brain tumor, meningitis, nephritis, exophthalmos, anemia, angioma of the choroid, and hypotony. Of genuine brain tumors there were 14 cases, which is a relatively small number when one considers that brain tumor is the most common cause of papilledema. In explanation of the small number ascribed to brain tumors and of the large number of various other diseases it was recalled that patients with brain tumors usually do not die during the time the swelling is at its height, but as a rule later, when the swelling has subsided and the disc is pale. Specimens of such atrophic papillae are apt to be filed in an anatomic collection in the general group of postneuritic atrophy rather than in the special one of papilledema. However, for the purely anatomic descriptions undertaken, one can proceed unhindered without knowing exact histories and clinical details.

DIFFERENTIATION OF RECENT AND OLD CASES

The nerve head may remain edematous for a number of months or even a year. Clinically an estimation of the duration of a case of papilledema is beset with difficulties and errors are possible. E. Fuchs reported a case that he had diagnosed clinically as an atrophy of the disc resulting from edema, whereas histologically he found very little atrophy of the nerve fibers. The paleness that misled him

* Read before the Oxford Ophthalmological Congress, 1937.

** Brain, 1910-11, v. 33, p. 389.

be attributed, from microscopic examination, to proliferation of neuroglia. Histologically, a differentiation between recent and old cases of papilledema may be made to a certain extent, so that an anatomic interpretation may be accepted as being as reliable, if not more so, than a clinical one. The following signs were employed in concluding whether a recent or an old case was being examined, bearing in mind that the various phenomena may persist long periods of time.

A. As indicative of short duration

1. Mere separation of the nerve fibers by a clear fluid, the columns of nuclei being in order and the nuclear elements showing no increase, but apparently a decrease due to their wider separation by fluid: The outlines of such a disc would still have been visible under the clear fluid.

2. Mere hyperemia of the capillaries but no increase in the nuclear elements of the wall.

B. As indicative of long duration

1. Atrophy of the ganglion-cell layer of the retina: This is usually demonstrable earlier than that of the nerve fibers, and it may be considered a more reliable index than that of the nerve fibers, since it is difficult to estimate, either clinically or pathologically, the amount of the disappearance of nerve fibers unless it is considerable.

2. Disappearance of the nerve fibers: This is especially apparent when the columns of neuroglia get out of order and because of the disorder appear to have increased. Clinically, this stage corresponds to that of the unmistakable blurring of the margins of the disc.

3. Proliferation of the endothelial cells of the capillaries and of the capillaries themselves, going side by side with a proliferation of the neuroglia: Such a general proliferation, together with the disorder of the cells, gives to the sections a very nuclear appearance, which is most characteristic of the older cases—the more the nuclei the more advanced the case.

4. Degenerative changes in the nerve fibers: Degenerative changes in the nerve fibers were usually in the deeper layers. By breaking down and becoming confluent, numerous fibers formed irregular, poorly staining, homogeneous masses that were not readily delimited from the interstitial coagulum. It is doubtful whether these degenerative changes were visible clinically because, by the time they occurred, it was likely that the surface neuroglia had taken on a membranous character. There were but three instances of varicosities in the nerve fibers, the so-called "cytoid bodies."

5. Hemorrhages: Occurring with the degeneration of the nerve fibers, a sparse, diffuse infiltration of red blood cells that had escaped by diapedesis, were often seen scattered in the tissues. Large hemorrhages, which were invariably located in the anterior layers, along the anterior declivity of the swelling, were infrequent.

6. Detachment of the membrana limitans interna: A blisterlike detachment of the membrana limitans interna by a clear albuminous fluid was encountered in several of the older cases, always placed low in the declivity of the swelling in the zone of the retina. The nerve proper is covered by a glial membrane on its nasal aspect; the pit and temporal aspect are normally free of any membrane.

7. Separation of the bundles of the lamina cribrosa: Not infrequently the anterior bundles, especially the choroidal portion, were found spanned out forward, evidently from the reversal of the current in the fluid, so that the anterior surface, instead of remaining concave became convex. According to Elsching,

this particular change is a most reliable sign of papilledema.

Cadaver changes

Before going further it is well to review cadaver changes with which one may have to deal in the study of the pathology of papilledema. In normal cadaver eyes a post-mortem swelling of the papilla is not unusual, and an inexperienced examiner might be induced to make a diagnosis of choked disc. The post-mortem edema is supposed to be caused by hypotension taking place after death, so that fluid in the optic nerve oozes forward through the holes in the cribriform fascia towards the area of lowered tension in the papilla, which it infiltrates and causes to expand. A factor in the production of post-mortem hypotension may be a constant escape of fluid through Schlemm's canal produced by the elasticity of the globe. Another factor may be an alteration that takes place in the colloid constituent of the vitreous body such as is associated with diabetes.

Cadaver detachment of the retina

A slitlike circumpapillary detachment of the retina was extremely common in the preparations. It was recognized by the presence of an almost colorless fluid containing *débris* of rods and cones, which of all the structures within the globe is the most prone to undergo post-mortem deterioration, although they retain their form and vitality a long time in an ordinary detachment in life. Occasionally nuclear elements from the external nuclear layer of the retina may be found in the subretinal space, having escaped through a breaking down of the membrana limitans externa. In cases of papilledema post-mortem detachment tends to a special localization around the disc, because of the disturbance of the normal anatomical relation between papilla and retina, owing to an increase in volume of the former. However, in post-mortem detachment the retina is never pushed aside or thrown into folds by the swollen papilla.

Measurements of the dimensions of the edematous papillae

A. Thickness: The thickness of the edematous papillae was compared to that of the retina, taken at a point on the nasal side, at a distance from the center of the papilla, corresponding to that of the foveal region on the temporal side. The nasal side was selected for this purpose as the retina is of more uniform thickness in this region than on the temporal side. The following comparisons were brought out: Papillae slightly thicker than the retina, 6; twice as thick, 19; three times as thick, 12; total measured, 37. The remaining 13 globes were cut too eccentrically for purposes of this comparison. In general, those papillae showing histological signs of long duration were less swollen than those of pure edema of recent origin.

B. The breadth: To measure the breadth of the lateral distension, the breadth of the optic-nerve canal at its inner opening was taken as a standard. The following comparisons were brought out: Papillae slightly broader than the optic nerve canal, 10; one third to one half broader, 11; from one half to one diameter broader (or more), 20; from one-and-a-half diameters broader (or more), 8; total measured, 49.

One may judge from the measurements in the first group that a broad lateral distension of the papilla is not an essential feature in papilledema, which would explain why the blind spot is at times so little enlarged.

Effects of the swollen papilla on the retina

From the pictures in most textbooks it would appear that the lateral distension

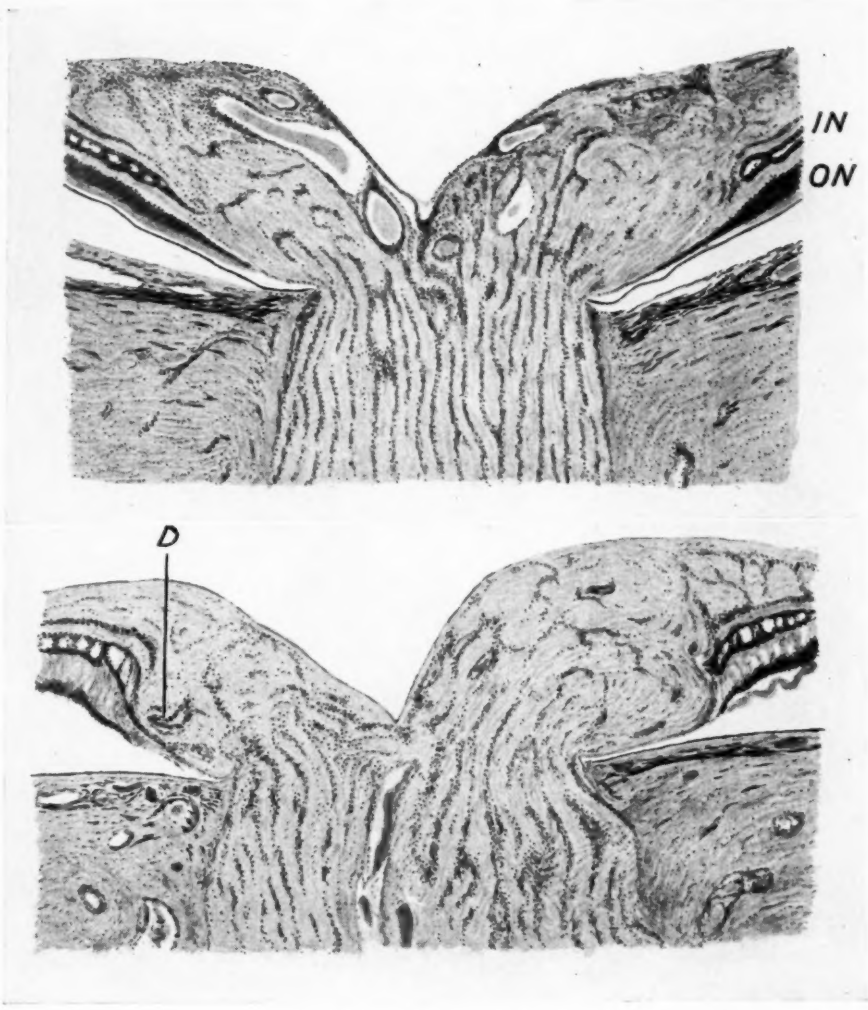


Fig. 1 (Samuels). Compressing type of papilledema. Outer nuclear layer (ON) reaches almost to nerve head, whereas inner nuclear layer (IN) is some distance removed. The central vessels are very much distended, and the capillaries appear as files of cells. The pigment epithelium is not affected.

Fig. 2 (Samuels). Depressing and displacing type of papilledema with circumpapillary cystic degeneration of retina. Proliferated capillary (D). The pigment epithelium is not affected.

of the papilla merely pushes the retina aside. According to the present material, such simple pushing aside of the retina is far from being the rule. It was present in only one third of the cases. In the picture of choked disc in the textbook of E. Fuchs the true condition is correctly shown. On one side the swelling overlaps the retina, pressing its edge backward, but it does not displace it. On the opposite side the swelling insinuates itself between the retina and the pigment epithelium, lifting the retina up. Therefore, in this one picture it is demonstrated that the lateral expansion of the nerve head may act on the retina in a way different from simply pushing it aside. From the standpoint of the mechanical effect of the

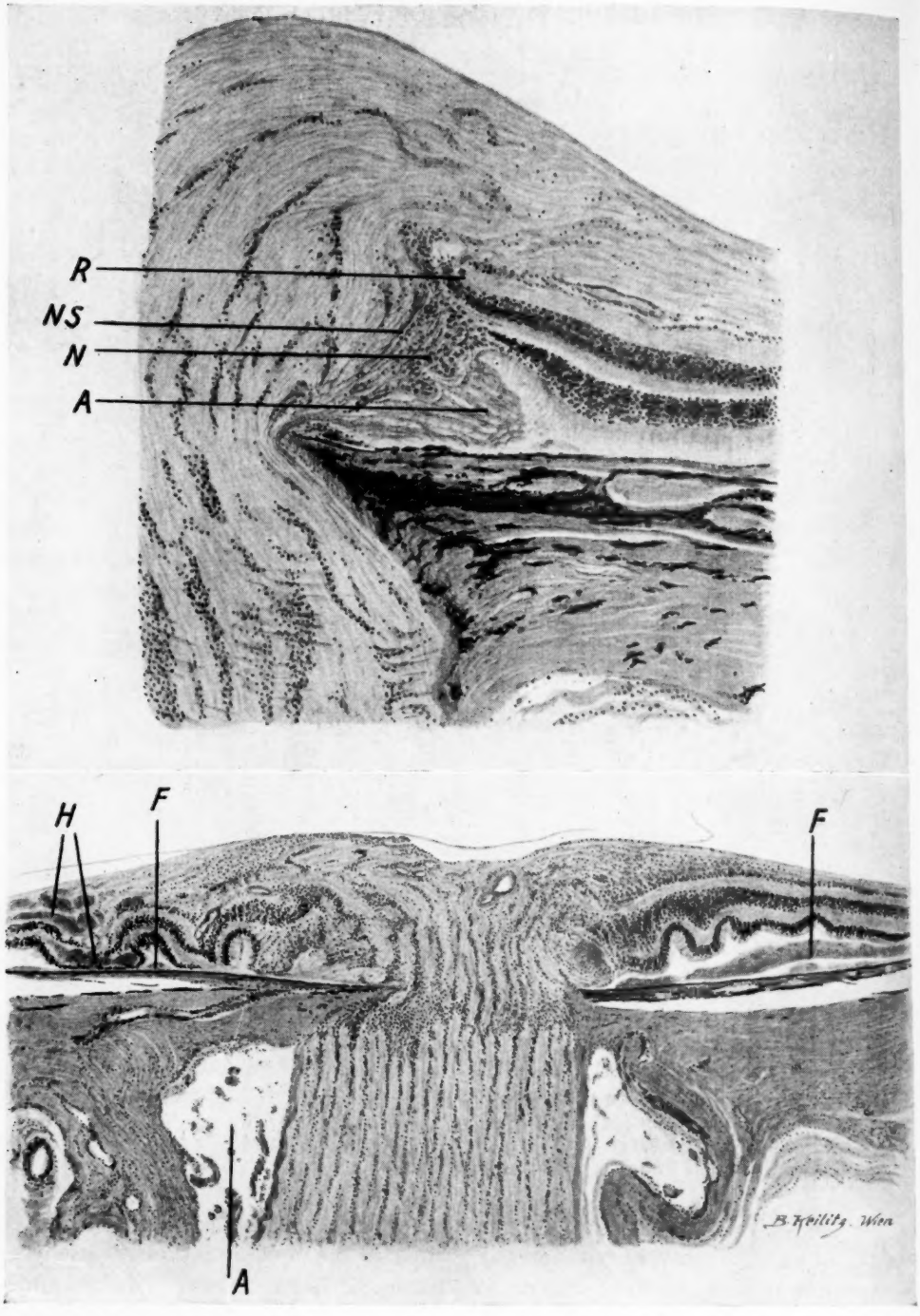


Fig. 3 (Samuels). The drawing was made of the nasal side. The neuritic swelling (NS) is plainly outlined. There is a triangular-shaped tissue lifting up the retina. It is composed of two areas, one at the base with many nuclei (N), and in intimate contact with the retina (R), and the other at the apex (A), poor in nuclei and of a peculiar appearance suggestive of coagulated fluid.

Fig. 4 (Samuels). The edematous papilla is well advanced in atrophy. The retina is detached by an albuminous fluid (F). It is very much folded and there are many hemorrhages (H). The intervaginal space shows an ampullalike hydrops (A).

swollen papilla on the retina the specimens fell into the following groups:

A. Compressing type of action: In 18 cases the edematous papilla compressed the retina and fused with it, producing but slight elevation. In these cases the inner nuclear layer was apt to be pushed aside a little, but the outer nuclear layer always remained in place (fig. 1). As a result of compression, the retina at its inner border was thinned and reduced to a sharp point. The compressing type of action was characteristic of the temporal aspect where the nerve fibers normally run obliquely over a relatively thin sheet of retina.

B. Displacing type of action: In 17 cases the principal action exerted was to push the retina aside (fig. 2). This action was more frequent and more marked on the nasal side than on the temporal side. The explanation is to be sought in the anatomy of the parts. The greater bulk of the nerve fibers together with the main retinal artery passes farther forward in the long axis of the globe on the nasal side; moreover, the neuroepithelial layers are thicker here than on the temporal side. When these vertically directed nerve fibers become edematous in expanding laterally, they mechanically push the adjacent relatively thick neuroepithelium to one side.

Edema of the retina

In 80 percent of the cases in which the retina was greatly displaced, corresponding to cases of a large lateral distension of the papilla, a decided edema was present. However, in a few cases in which the lateral distension of the papilla was not highly developed, the retina was, in spite of this, considerably swollen.

Measurement of the thickness of the retina at the circumference of the papilla

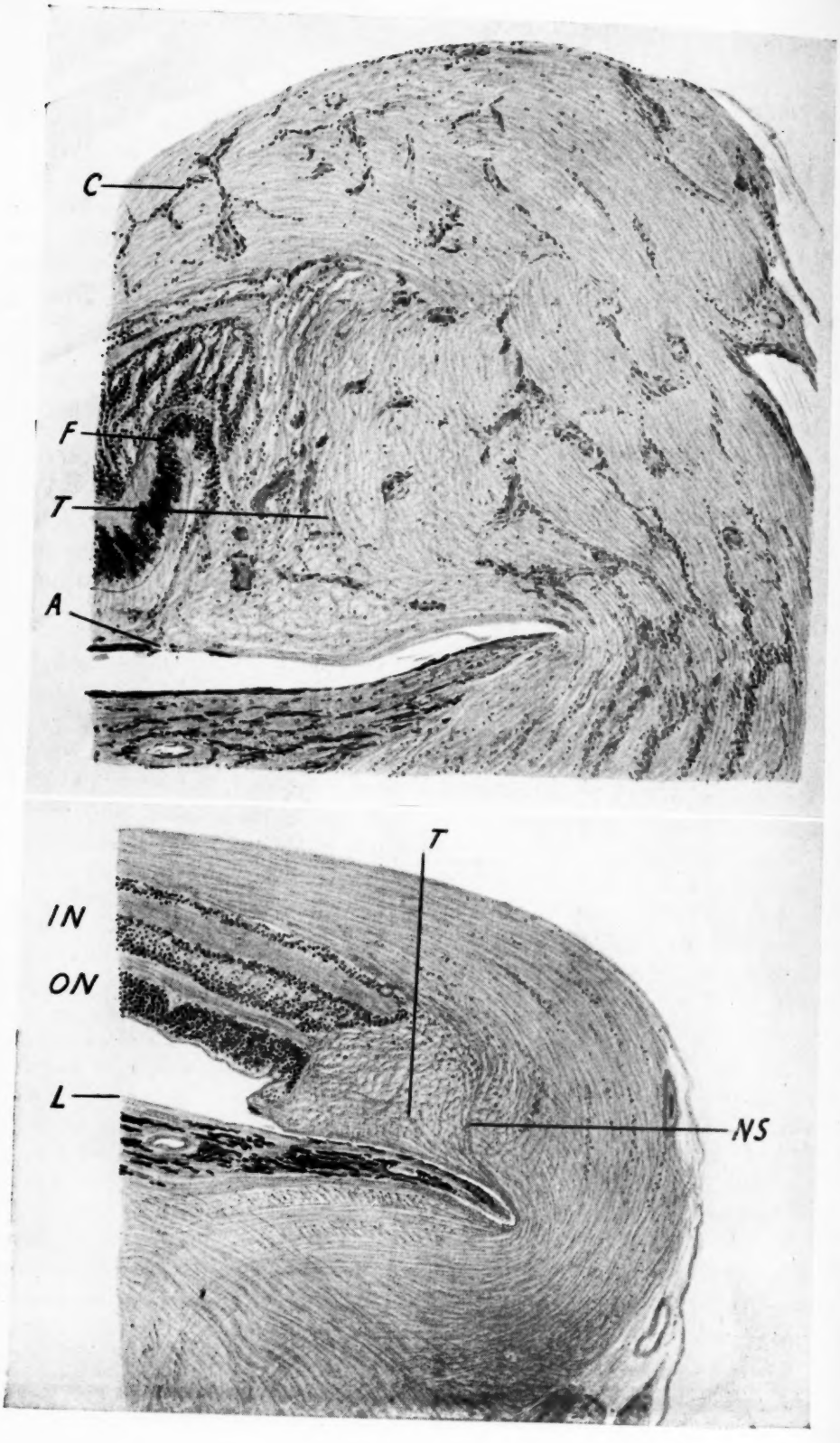
The thickness of the retina at the circumference of the edematous papilla was compared with that of the retina far enough away to be out of the field of edema. It was found that the thickness at the papilla showed great variation, being twice, three, or four times as thick as it was in the area from which the standard of measurement was taken. Such a method of estimation was a rough one, but it afforded an idea of the amount of fluid transferred from the papilla into the nerve-fiber layers of the retina, the increased thickening being mostly due to fluid separating the nerve fibers (fig. 3).

Cystic degeneration of the retina

The peculiar texture of the retina, which is different from that of the optic nerve, prevents the former from expressing much fluid into it. The structure of a tissue determines the amount of fluid that can be collected within it.

The papilla lends itself readily to edema because it is composed only of nerve fibers and of neuroglia all running parallel to one another and being so loosely disposed that they are readily separated by fluid. On the other hand the retina is a thin layer, and its chief constituents run at right angles to one another. The nerve fiber and nuclear layers run parallel to the surface, and the supporting fibers, the so-called supporting tissue of Heinrich Müller, run vertical to the surface in such a way as to bind down the flat elements and prevent their separation by fluid. Therefore, the area in which the greatest amount of fluid may accumulate is limited, posteriorly by the resistant lamina cribrosa, and anteriorly by the vertical pillars of the supporting tissue of Heinrich Müller. Clinically the fluted and rather sharply defined margins of some swollen papillae mark the anatomical boundary between the nerve-fiber layer of the papilla and that of the retina, the former possessing, and the latter not, the property of expanding.

Almost invariably, whenever the edema


C
F
T
A
T
IN
ON
L
NS

was intense in the papilla, there was found a system of circumpapillary cystic degeneration in the retina. There are three distinct systems for cystic degeneration in the retina: The circumpapillary (fig. 2), the macular, and that of the ora serrata. The macular system may develop not only from disturbance of circulation, but also from toxins reaching it from within or from without the globe, as in chronic iridocyclitis or inflammatory processes in the orbit. In connection with circumpapillary cystic degeneration, several cases showed macular cystic degeneration. The systems of circumpapillary and macular cystic degeneration encountered gave no evidence of the transference of the fluid from the papilla as takes place into the nerve-fiber layer. The serum that caused the spaces was in all probability a transudate from the capillaries of the retina in response to an increase in capillary pressure from congestion.

Detachment of the retina

In the entire survey there were eight cases in which the retina showed a narrow slitlike detachment, taking in a considerable area surrounding the nerve (fig. 4). In one case it extended into the macular region. The detachment was generally associated with a marked edema of the nerve head. The subretinal fluid seemed to come mostly direct from the nerve head at the margin of the lamina vitrea, the space suggesting a sort of sluiceway for the escape of fluid dammed up in the papilla.

Comparison of papillary edema, circumpapillary edema, cystic degeneration in the retina, and detachment of the retina

In comparing the amount of edema in the papilla with the edema and cystic degeneration in the retina, it was shown that where the edema was intense in the papilla it was correspondingly so in the nerve-fiber layer of the retina, and that at the same time cystic degeneration in the neuroepithelial layers was highly developed. This relation held good, especially for papillae that showed the displacing and elevating types of action on the retina. Cystic degeneration was seen less often in the compressing type.

Effects of intraocular pressure on shape and size of the edematous papilla

The edematous papilla would tend to spring forward and to expand more along the median line, as it does in the papilledema of hypotony, did not the intraocular pressure exerted through the vitreous tend to press the nerve head backward, causing it to expand laterally and to express its fluid into the nerve-fiber layer of the retina. Following this theory, as Parker pointed out in 1924, papilledema in a globe with low tension is apt to assume greater dimensions, especially in the matter of elevation, than in one with high tension, it being considered that high intraocular pressure acts as a supporting cushion to the framework

---

Fig. 5 (Samuels). An enormous neuritic roll extends to T. A vascular triangular tissue has its apex at A, where there is an hypertrophy of the pigment epithelium. This tissue has pushed the retina, lifted it up, and thrown it into folds (F). Proliferated capillaries at C.

Fig. 6 (Samuels). The drawing is from the nasal side. At the edge of the neuritic swelling (NS) there is a large triangular tissue (T) similar to that at A in figure 3, the apex of which protrudes between the retina and the pigment epithelium. The outer nuclear layer (ON) is more pushed aside than the inner (IN). Lamina vitrea (L).

of the papilla, enabling it to withstand pressure exerted by fluid within its meshes without much stretching. The compressing and displacing types of action on the retina were believed to be associated, respectively, with a high and a low normal of intraocular pressure, suggesting the desirability of an accurate taking of tension in all cases of papilledema.

Production of folds in the retina

Wrinkles in the membrana limitans interna of the retina were not infrequent. Occasionally a low detachment of this membrane was seen. The wrinkles account for the light streaks often seen clinically in the retina running concentric with the nerve. The detached areas of the membrana limitans interna Paton and Holmes refer to as "œdema vesicles," stating that they are most frequent on the macular side of the disc.

Circumpapillary space

In those cases in which a greatly enlarged papilla exerted an elevating type of action on the retina, a triangular space was often found, having for its boundaries the papilla, the retina, and the pigment epithelium. In the embryo there is a free space of sinus in this identical location, being analogous to the ring sinus of Szily at the pupillary border, and like it becoming obliterated in the fully developed eye. The circumpapillary space plays an important role clinically, because pigmented granules and red blood may find their way into it and may be visible with the ophthalmoscope. The development of chorioretinitis juxtapapillaris and of circumpapillary sarcoma, the clinical distinction between the two being difficult, are other conditions that call one's attention to the circumpapillary zone.

Tissue in circumpapillary space

An especially large mass of peculiar tissue, almost never seen in normal eyes, and then only in small quantity, was encountered in the circumpapillary space in 54 percent of the material. It was even seen in ordinarily stained preparations.

Differentiation of the neuritic roll from the circumpapillary tissue

The term "neuritic roll" applies to the lateral expansion of an edematous papilla, and ordinarily is made to include the tissue above referred to, which in reality does not belong to the nerve bundles proper. In this paper the term "neuritic roll" is used in a restricted sense, meaning the lateral bulge of the papilla only in so far as it is composed of typical nerve bundles (fig. 5), all forming one mass held together by the same framework and all readily identified as papillary nerve tissue. In 46 percent of the cases the neuritic roll was apparently free of any peculiar tissue clinging to its borders. A clean-cut neuritic roll was responsible for most of the cases in which the retina was simply depressed or pushed aside without being elevated.

Circumpapillary tissue. The circumpapillary tissue was, as a rule, of triangular shape, the base resting on the neuritic roll, with the sides bordering on the retina and the pigment epithelium (fig. 6). Due to its shape, size, and location, this tissue had an elevating effect on the edge of the retina. In some instances it was developed as a mere bud and then it exerted a pushing effect on the external nuclear layer, or it insinuated itself between the external and the internal layers (fig. 7). In a few of the cases the tissue appeared as a broad, rounded cushion or collar that encircled a papilla so far drawn forward

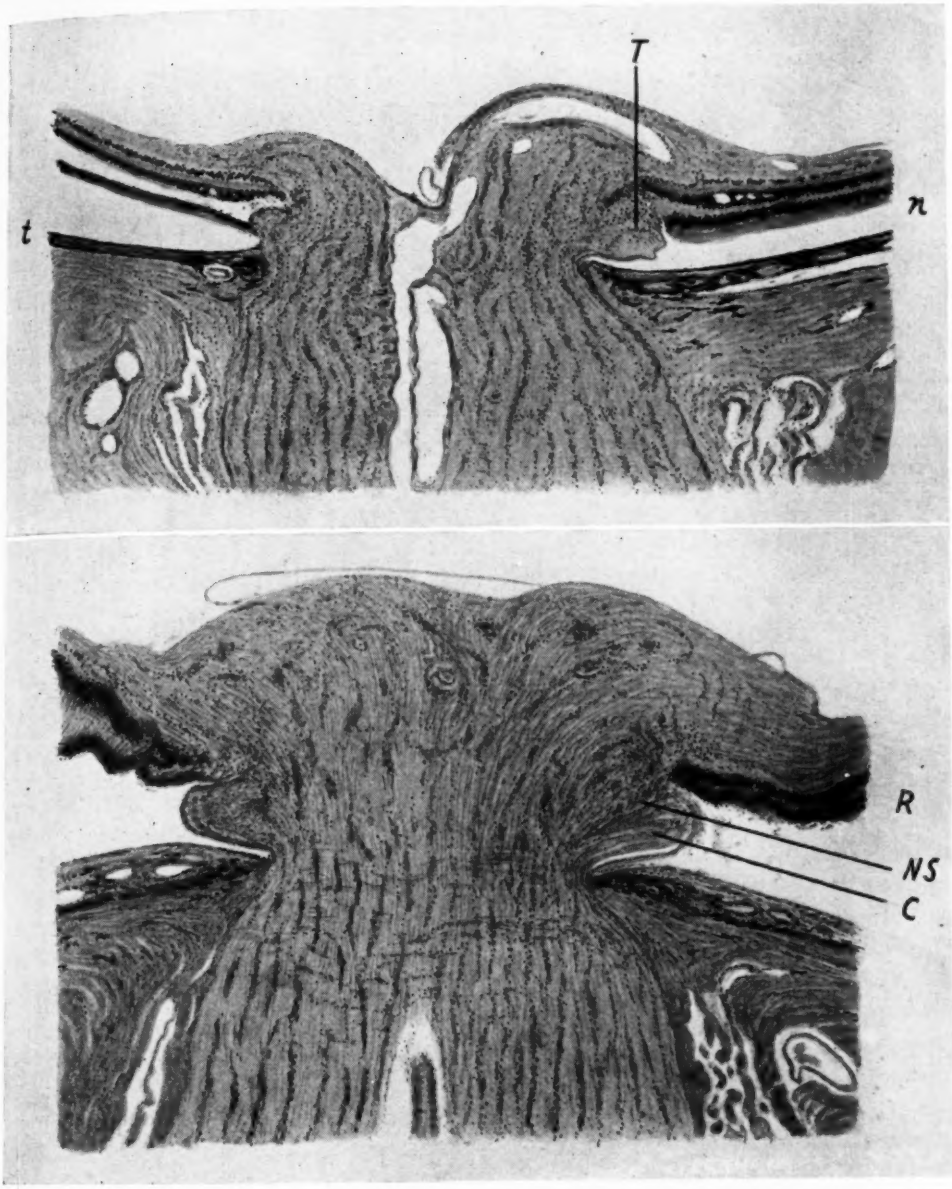
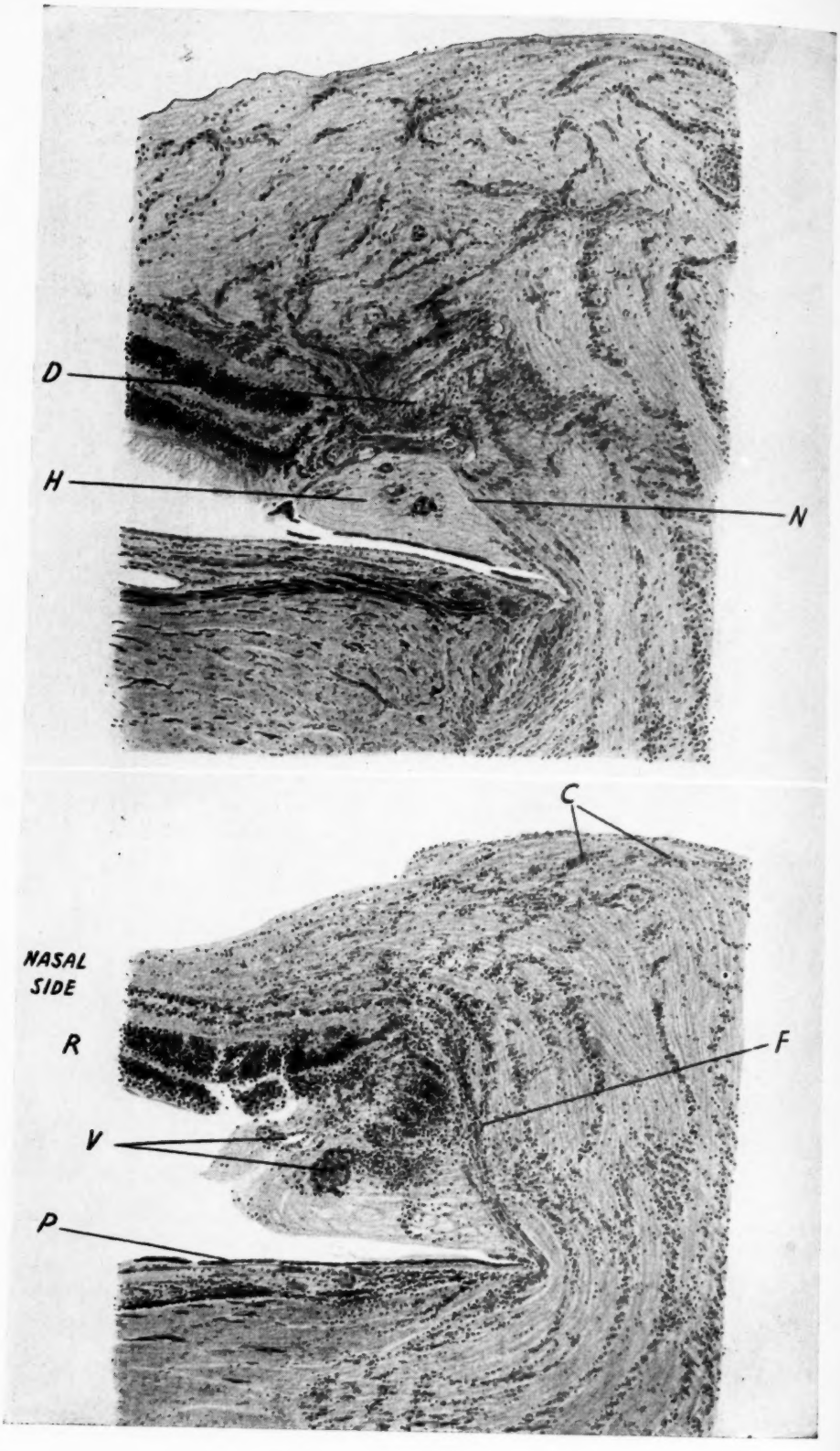


Fig. 7 (Samuels). On the temporal side (left) there is a small nodule pushing the outer nuclear layer aside. On the nasal side (right) a large triangular tissue (T) projects against the outer nuclear layer, composed mostly of neuroglia tissue. Early circumpapillary cystic degeneration of the retina is present.

Fig. 8 (Samuels). A cushion-shaped tissue projects between the retina and pigment epithelium. On the right side the outline between the neuritic swelling (NS) and the cushion-shaped tissue (C) is plainly seen, the latter being poor in nuclei and staining faintly.


D
H
N
C
NASAL
SIDE
R
F
V
P

as to form a slender neck surmounting the internal opening of the nerve canal (fig. 8).

Types of circumpapillary tissue

The characteristics of the circumpapillary tissue varied, so that three types were differentiated:

1. A more or less homogeneous mass that could easily have been mistaken for coagulated fluid, had not the higher power revealed a few glial cells and a fibrillar structure (fig. 9).

2. A very loosely and irregularly meshed tissue, poor in nuclei (fig. 6).

3. A compact, very cellular tissue reminding one of neuroglia proliferation as it is seen in an atrophic retina (fig. 10).

Commonly types 2 and 3 were found together, the denser, more nuclear type filling out the base of the triangular space and the loosely meshed framework the apex (fig. 2).

Age of circumpapillary tissue

The picture in the circumpapillary space varied according to the duration and development of the edematous process in the nerve head proper. In the recent stage the irregularly disposed nuclei at the base of the triangular space stood out by contrast against the neuritic roll with its longitudinal striations of nerve fibers and orderly rows of nerve bundles and glial cells (fig. 10). It is the separation of these bundles of nerve fibers by edema that is the cause of the nerve-fiber radiations, over an edematous papilla as seen clinically. These radiations, by not all ending in the same line, will explain the fluted outline of an edematous papilla.

In an advanced stage the nuclear elements of the base were found to have invaded the apex, so that the whole mass presented a very nuclear field which blended almost imperceptibly with the neuritic roll in which, by this time, the nerve fibers had disappeared as such, and the columns of nuclei were out of order. Consequently the various changes in the circumpapillary tissue showed a parallelism to those in the neuritic swelling. This was even true at times in the development of congeries of capillaries in the triangular tissue along with their development in the neuritic roll (figs. 6 and 10). They were derived from the vessels of the papilla.

Cases of special interest

In most instances the distance of the apex of the triangular tissue from its base at the neuritic roll measured from one third to one diameter of the nerve canal, as already recorded, but in four instances the tissue was drawn out into a long tapering point, perhaps two optic-nerve diameters or more from its base at the border of the neuritic swelling (fig. 11). In these cases the pointed apex of the flap was adherent to the pigment epithelium. In two there was considerable hyperplasia of the pigment epithelium at the apex, indicating slight inflammation, such as is seen in low-grade chorioretinitis (fig. 14). In another case considerable

Fig. 9 (Samuels). The papilla is enormously swollen and many proliferated capillaries and neuroglia cells indicate that the edema had existed sometime. Between the neuritic swelling (N) and the pigment epithelium there is interposed a hyalinized tissue (H). At D there is an especially dense and nuclear field of neuroglia and blood vessels. The circumpapillary tissue has raised and displaced the retina. The retina is not folded, and there is an absence of cystic degeneration.

Fig. 10 (Samuels). The fibers of the papilla (F) may be traced into the retina. Between the retina (R) and the pigment epithelium (P) there is located a large mass of circumpapillary tissue containing blood vessels (V). The posterior layers and the apex are becoming nuclear by invasion from the anterior neuroglia field. Proliferated capillaries (C). The pigment epithelium (P) is poor in pigment.

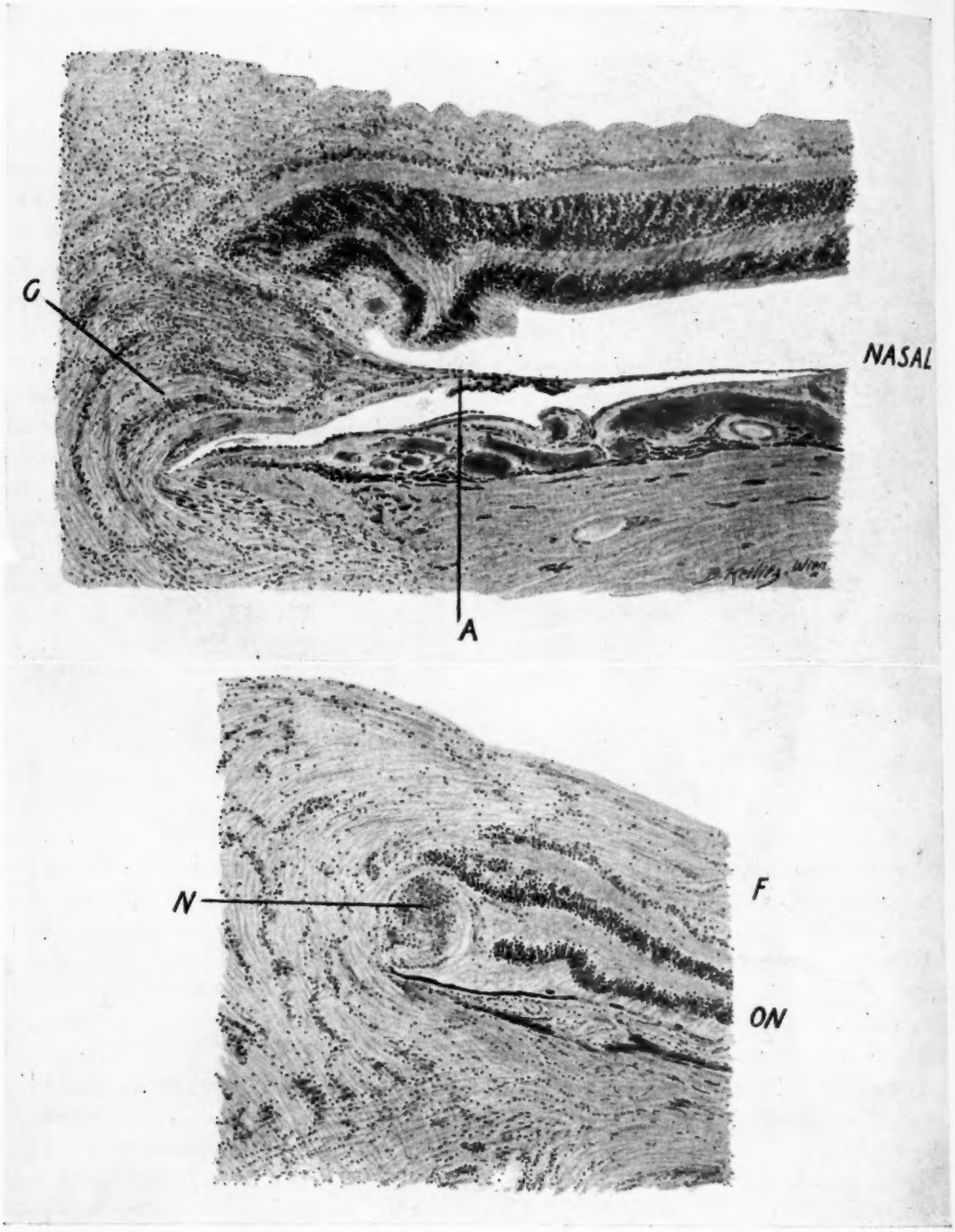


Fig. 11 (Samuels). A long flap-shaped tissue is connected to the pigment epithelium at A on the nasal side. At the sharp point of the flap there is an hypertrophy of the pigment epithelium. Between here and the nerve canal this layer is poor in pigment. Glial cells (G).

Fig. 12 (Samuels). Nerve fibers pass forward at the edge of the papilla into the nerve fiber layer of the retina (F). The edematous nodule of neuroglia (N) represents the intermediary tissue to Kuhnt, situated here on the temporal side. It lies between the inner nuclear layer and the pigment epithelium. Outer nuclear layer (ON).

hyperplasia had also taken place at the base. These four cases were all old and very nuclear. They were probably formed by a rupture in the delicate fibers at the apex of the tissue permitting frayed-out fibers to extend far outward. In two of the four cases the neuritic roll proper seemed to enter into the formation of the base of the tongue-shaped flap, forming a hernia (fig. 13).

Origin of circumpapillary tissue

A. The nuclear element of the tissue: The nuclear tissue at the base of the triangular space was undoubtedly derived from a proliferation of Kuhnt's intermediary tissue (fig. 12). He described a collar of pure neuroglia having a circular fibrillation, interposed between the nonmedulated nerve fibers of the papilla and the neuroepithelium of the retina, with which it is in intimate relation, and from which it may be difficult to distinguish it. The collar is not well developed in all eyes. As a rule it is better developed on the nasal side. Inasmuch as the optic-nerve fibers are more numerous on the nasal than on the temporal side and the intermediary tissue of greater bulk here, when edema sets in it is here that the swelling will be more pronounced, due not only to imbibition of fluid by nerve fibers, but also by the intermediary tissue. It may be that this particular tissue possesses to a marked degree the property of imbibing fluid and swelling, just as does the neuroglia of the peripheral glial mantle of the optic nerve in papilledema, as described by Paton and Holmes.

B. The loose tissue, with few nuclei at the apex: The loose, poorly stained tissue at the apex was traced to its source of origin from a compressed homogeneous stem of nerve fibers situated at the sharp margin of the nerve canal at the lamina vitrea. From this point of constriction countless nerve fibers directed forward and relieved of compression spread out like a fan. By means of swelling and breaking up of the fibers and accumulation of fluid, the loose, poorly staining tissue at the base of the triangular space was thought to be produced. Occasionally the return of the expanded nerve fibers to the main bulk of the nerve could be followed (fig. 8).

However, the fibers were not considered to be ordinary axis cylinders, otherwise they would not have been so extensile. They probably represented a neuroglia framework similar to that of the peripheral mantle of Fuchs in the nerve trunk, which has a decided capacity to imbibe fluid and swell. As it was, the peripheral bundles of the edematous nerve peeled off, like the bark of a tree, to form a part of the circumpapillary tissue, leaving the main stem clean and sharply defined.

The pigment epithelium

Alterations that took place in the pigment epithelium were considered of special interest because of their importance from the standpoint of differential diagnosis. Thus no alteration in an atrophic papilla may speak for primary atrophy, whereas a disappearance or a heaping up of pigment would indicate atrophy from edema. The main alteration was found to be a flattening of the cells and a loss of their pigment granules, due to pressure and traction exerted by the circumpapillary tissue advancing and contracting over it. These changes were apparent in about half of the cases. In only six cases had the pigment epithelium entirely disappeared. In several cases there was a heaping up of pigmented cells as mentioned before.

Clinical case showing hyper- and hypoplasia of the pigment epithelium

A woman suffered from poor vision in the right eye. The left eye had always

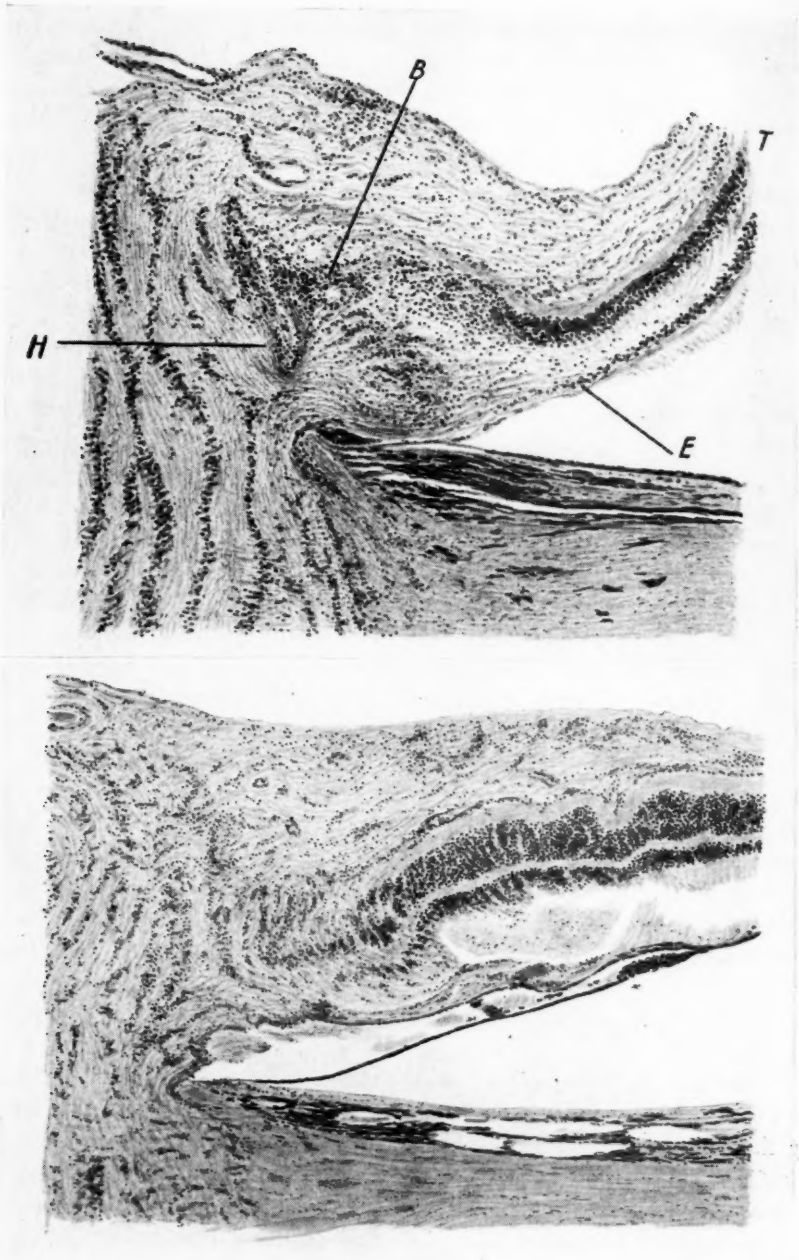


Fig. 13 (Samuels). The inner nuciear layer (T) can be traced to B. The outer nuclear layer reaches only to E. At H a large number of nerve fibers escape into the circumpapillary space giving the impression of a hernia. Below the hernia there are hypertrophy and atrophy of the pigment epithelium.

Fig. 14 (Samuels). The flap of circumpapillary tissue is long drawn out from the nerve. At its apex there is an accumulation of pigment, which clinically would probably have presented a coal-black crescent far removed from the margin of an atrophic disc.

been inflamed and was partially blind. Its fundus was not visible. In the right fundus a characteristic postpapilledematous atrophy was present (fig. 15). The disc had a yellowish tinge, and there were no details of the lamina cribrosa. The arteries were attenuated, but none of them showed a sheath. The veins were dilated. On the nasal side, at the immediate border of the papilla, there was a narrow, coal-black crescent, and bordering this was a broad white crescent, surrounding which was another broad crescent of a bluish-black color. The three crescents, more or less changed in color and breadth, extended around the nerve head, except at the lower quadrant, where they failed.

Especially in favor of a diagnosis of papilledema was the breadth of the zone involved around the nerve head, suggesting that an unusually long flap of tissue had once been present in the circumpapillary space. The pigmented and nonpigmented crescents spoke for hyperplasia and hypoplasia of the pigment epithelium, respectively. The entire area had a quality of softness about it, as if it were seen through a delicate translucent veil. This quality was probably given to it by a gliosis of the retina. The cause of the supposed papilledema was never ascertained.

Intervaginal space

Although the state of the intervaginal space did not belong directly to the theme of this paper, yet it seemed not inappropriate briefly to record observations made on its size and contents which may be of special statistical and general value, owing to the large number of globes examined. It was possible to make use of specimens from 47 cases, those of the remaining three not serving because of hypotony from rupture of the sclera or from severing of the nerve too close to the sclera. In 23 cases the intervaginal space appeared to be normal. In 22 cases it was dilated, with an ampullalike formation in a majority (fig. 4). In 11 of the 22 cases coagulated fluid was seen in the arachnoid space. In many instances the arachnoid was pressed against the dural sheath,

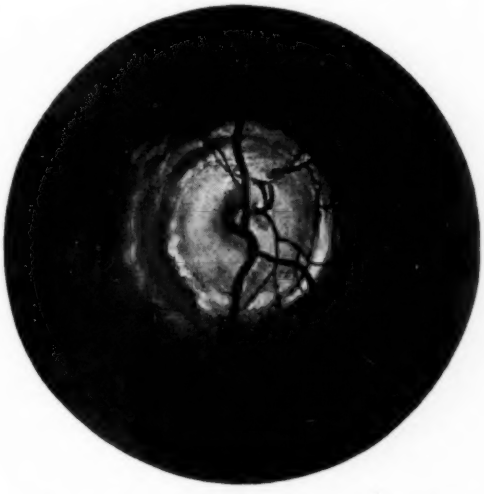


Fig. 15 (Samuels). The crescentic zones surrounding the atrophic nerve head are interpreted as representing tracks left in the pigment epithelium by an unusually large mass of circumpapillary tissues developed in the course of papilledema.

and its trabeculae were expanded. That no fluid could be found in a number of cases was due to the fact that the nerve was excised too close to the sclera, allowing the fluid to be lost at the time of enucleation. Although the fluid in the intervaginal space is rich in albumin, in cases of brain tumor or meningitis, yet it it not albuminous enough to coagulate after death. This it does only under the influence of the fixation fluid. Therefore, in choked disc, unless a long strip of nerve is carefully excised, the intervaginal fluid readily escapes.

In investigating the amount of intervaginal hydrops and the amount of swelling of the papilla, it was not possible to establish any relation between them. It

was not so that when there was extreme edema of the papilla there was a corresponding amount of hydrops, or that when there was no edema there was no hydrops. There were nine cases with a considerable amount of hydrops, and yet the optic nerve showed very little edema. It may have been that death supervened before sufficient time had elapsed for edema to establish itself in the papilla.

Comment

By the method of focal examination of Koeppe, one may see the detachment of a delicate membrane over the nerve head which is considered to be the earliest clinical sign of edema, whereas the lateral expansion of the nerve is the first demonstrable sign under the microscope. By means of photographs a record may be kept of the varying phenomena of papilledema with an accuracy and fidelity unattainable with drawings. In the light of the present survey the details at the sides and margins of an enlarged papilla take on new clinical interest and interpretation.

1. A papilla seen clinically with moderate increase in elevation and circumference would probably show under the microscope the neuroepithelial layers of the retina to be compressed. In the atrophic stage one should expect little or no change in the pigmentation at the border, so that such a nerve head could not be differentiated clinically or pathologically from primary atrophy.

2. A papilla in which the swelling is clinically high on the nasal side and relatively low on the temporal side anatomically would be apt to show displacement of the neuroepithelium on the former, and compression on the latter side.

3. Those cases in which the elevation of the papilla is very great and the borders steep clinically would correspond to those seen pathologically with a large circumpapillary space filled with the characteristic tissue already described.

4. A marked dilatation of the retinal blood vessels may be taken as a sign of constriction in the capillaries caused by folds in the deeper layers.

5. In cases in which an enlarged blind spot is not to be accounted for by the breadth of the papilla, the existence of a slitlike detachment of the retina should be suspected. Over such a detachment the retina was usually found in the specimens to be but little folded.

6. When the edema is very great, what we see is not all optic nerve, but much of it is a broad zone of cystic retina and circumpapillary tissue.

7. In the stage of complete atrophy one should not expect to see with the ophthalmoscope any vestige of circumpapillary tissue, for this disappears along with the nerve fibers.

8. A disturbance of pigmentation is to be looked for clinically, on the nasal side, either at the immediate margin of the disc or at a considerable distance away. These are the only permanent tracks left by the circumpapillary tissue.

9. Routine examination study should be made of the macular region for evidence of cystic degeneration in cases of papilledema.

57 West Fifty-seventh Street.

VALUE OF MUSCLE-BALANCE TESTS IN ROUTINE REFRACTION*

JAMES E. LEBENSOHN, M.D.
Chicago

In the initial examination, after the visual acuity of each eye has been ascertained, the patient should always be tested binocularly. If with both eyes open, the subject does not see or think that he sees better than with the better-seeing eye alone, a significant muscular disturbance is to be suspected. In any case, the thoroughgoing examiner will find that the results of a preliminary check of the muscle balance before the refraction compared to the data derived with the exact correction worn is an important guide to the probable influence of refractive error on any discovered phoria.

In the routine case of refraction the muscle balance vertically is perhaps of most importance.** The correction of a significant hyperphoria means much to ocular comfort, and has often dramatically terminated heachaches, misdiagnosed as "migraine," or other cerebral condition. A man, 41 years old, had been treated for some years in the various departments of a local university. He consulted me because of difficulty in seeing with the glasses there prescribed. His prescription was entirely correct as far as it went: vision, R.E. with +.75 D. sph. was 20/15; L.E. with +1.00 D. cyl. ax. 75° was 20/20; but a left hypophoria of 4.5 prism diopters had been overlooked. With the incorporation of 4 prism diopters, base up, in the left lens comfortable binocular vision resulted.

Olsho has shown that in the commonly found low degrees of anisometropia, the prism imbalance created when looking down can often be significantly diminished by correcting the minor errors of hyperphoria that are present. To the spherical power of the lens is added the power of the cylinder in the vertical meridian, as obtained from tables. The total gives the number of prism diopters acting when looking down 1 cm.; plus lenses giving prism base up; minus lenses prism base down. The difference in this value of the right and left lenses is the amount of artificial hyperphoria thus produced. When the correction of minor degrees of hyperphoria that are naturally present tends to correct the artificial hyperphoria induced when looking down, the correcting prism should be prescribed; otherwise not.

Accommodation and convergence are integrated functions, and lateral-muscle imbalance can often be effectively aided by stimulating or repressing the accommodation as the case requires. The tyro is too thoroughly taught that the desirable correction is the maximum plus or the minimum minus lens that the patient will accept. This is the rule for esophoria, and is unobjectionable in orthophoria, but in exophoria the hyperopic subject must be undercorrected and the myopic overcorrected. The strain of accommodation is better tolerated than the strains induced by marked muscle imbalance. In emmetropia, one diopter of accommodation is associated with one meter angle of convergence or 6 prism diopters when the interpupillary distance is 6 centimeters. The normal synkinesis is disturbed in ametropia, the hyperopic subject ex-

* From the Department of Ophthalmology, Northwestern University Medical School. Read before the Chicago Ophthalmological Society, February 21, 1938.

** Lateral muscular imbalance should, of course, be tested with the correction, but vertical muscular imbalance is probably better determined without lenses, inasmuch as a slight decentration of the latter induces misleading values.

ercising relatively greater accommodation, the myopic relatively more convergence. Since the convergence mechanism is overstimulated by the accommodation in hyperopia, understimulated in myopia, esophoria most frequently occurs in the one, exophoria in the other. The precise correction tends in time to establish normal relationships, but if the patient has difficulty, proper stereoscopic exercises, as suggested by Pascal,[1] facilitates the neural adjustment required.

In cases of convergence insufficiency, however, the hyperopic individual will be uncomfortable with his full correction. A psychologist, aged 32 years, who was refracted at a university clinic under homatropine, found difficulty in reading with his glasses, and was again refracted under atropine. The refraction prescribed was correct, R. +1.00 D. sph.; L. +1.25 D. sph.; but, though orthophoric for distance, he had 15 prism diopters of exophoria for near. I reduced his lenses by a half diopter, and added to each 2 prism diopters, base in; the spectacles to be used for reading only. The following year, the exophoria was 6½ prism diopters for near; and the prisms prescribed were reduced to 1 prism diopter, base in, for each lens. A year therafter, the exophoria for near was 5 prism diopters, and the prisms were discarded. This case illustrates that in convergence insufficiency prisms for restricted use are of definite value.

Many myopic individuals with marked convergence insufficiency find that one eye tends to wander out in doing close work. Such cases are often adequately treated by simple overcorrection. A printer, aged 30 years, complained of asthenopia in close work, a sense of haze, and sporadic double vision. His vision corrected by R. —3.00 D. sph. ⊂⊃ —.25 D. cyl. ax. 180°; L. —2.50 D. sph. was 20/15 in each eye. Further examination disclosed: for distance, 5 prism diopters exophoria; 1½ prism diopters left hypophoria; for near, 12 prism diopters exophoria, hypophoria same. He was given 1 prism diopter for his hypophoria, and overcorrected one-half diopter.

The principal cause of the discomfort in anisometropia is due to the artificial heterophoria created whenever the eyes move from the primary position. The other disturbing factors are of relatively minor import. Contrary to a prevailing misconception, the aniseikonia is diminished by the full correction. In uncorrected axial ametropia, a 2-diopter difference means 4-percent difference in the size of the retinal images; but when corrected the difference is only 0.55 percent. Though the ocular accommodation is affected unequally in anisometropia, a disparity of 10 diopters produces a differential of only 0.75 D. in the accommodation.

Children adapt themselves rather readily to anisometropic corrections of even high degree. The full corrections should always be ordered, and if one eye is amblyopic its vision should be developed by periodic occlusion of the better eye.

Anisometropia in adults presents four possible conditions: (a) binocular vision; (b) simultaneous vision without fusion; (c) alternating vision, one eye being used for distance, the other for near; (d) monocular vision. The condition is common, one-twelfth of the refractions presenting this problem, and muscular imbalance is especially frequent in this group. According to Duane's figures,[2] a hyperphoria of 1 prism diopter or over can be expected in one third of the cases, a significant lateral deviation in over half; and in this division, about half, 25 percent of the total, present a manifest squint, convergent in 11 percent, divergent in 14 percent.

Binocular vision should be promoted when possible. The prismatic disparity in the lenses can be reduced by proper

coflexures. The stronger plus lens or the weaker minus should have a relatively flat back surface, while the back surface of the weaker plus or stronger minus lens should be deeply curved. Lenses so designed reduce also the size disparity in high hyperopia and refractive myopia, but with axial myopia the reverse is true. In hyperopic anisometropia, the prismatic difference in the reading field can be compensated by adding a suitable prism, base down, as a bifocal segment to the stronger plus lens.*

This procedure is illustrated in the following case: A man, aged 20 years, a clerk, proved to have vision when corrected by R. +3.00 D. sph. ⊂⊃ +1.00 D. cyl. ax. 30°, of 20/30; L. +.75 D. sph. ⊂⊃ +.75 D. cyl. ax. 75°, of 20/15. The vertical power in the right eye was +3.75 D.; in the left eye +.80 D. The 2.95 D. difference gave at 8 mm. down a prismatic disparity of 2.36 prism diopters, base up, in the right eye. Consequently a compensating prism bifocal, 2 prism diopters, base down, for the right eye, was ordered. A better solution optically would have been contact glasses in both eyes, since the contact glass moves with the eye, thus creating no artificial heterophoria in any part of the field.

For the higher degrees of anisometropia, which occur with monocular aphakia, a contact-glass correction is not always adequate. Though the ordinary spectacle correction produces a 25-percent increase in the size of the retinal image, with a contact glass the size difference is still 11.5 percent. However, this magnification can be easily equalized, utilizing the principle of the Galilean telescope; by fitting the unoperated-on eye with a contact glass, also rendering it 3 D. hyperopic, and correcting this difference by ordinary spectacles (Boeder[3]). Equally effective, but less cosmetic, are the anisometropic spectacles of von Rohr,[4] by which up to 20 D. difference can be compensated. By a system of three lenses the retinal and prismatic disparity is equalized, and chromatic, spherical, and astigmatic aberration corrected for a solid angle of 25 degrees. The use of these special spectacles is limited by their appearance, which resembles that of a telescopic spectacle. Dr. Sanford Gifford in 1933 presented before the Chicago Ophthalmological Society a patient operated on for traumatic cataract in one eye. The patient wore lenses constructed on this principle and secured comfortable binocular stereoscopic vision.

With ordinary spectacles, however, the anisometropic adult cannot wear glasses generally in which the difference exceeds 2 diopters. At this limit 1 prism diopter of artificial hyperphoria is produced when the gaze is shifted 5 mm. below the base line connecting the optical centers. As this is within the tolerable compass, a slight associated movement of the head downwards secures comfortable reading vision. But the higher errors of anisometropia are a poser. A haphazard reduction, with the expectation that accommodation will take up the slack, is unwarranted. Accommodation is an integrated mechanism that acts practically always in both eyes equally, and even a half-diopter difference cannot be easily sustained. Where the corrected acuity is about equal in both eyes, why not abandon the attempt to secure binocular vision, with its unavoidable muscular asthenopia, and promote, instead, alternating vision, adapting one eye for distance use, the other for near? With the

* S. Duke-Elder ("Practice of refraction." Ed. 3, Philadelphia, P. Blakiston's Son & Co., 1938, p. 121) suggests that the difficulties in anisometropia may be occasionally solved by making the stronger lens a disc bifocal, with the center carrying the full correction, and the periphery about the same strength as the weaker glass.

use of one eye at a time, the demand for balanced muscular activity is annulled, and symptoms from incoördination cannot arise. The most favorable subjects for this method are subjects with anisometropic myopia, who, because of the unequal progression of their myopia, have frequently developed a natural tendency to this alternate vision. The idea is worth trying also in cases of presbyopic hyperopia. If successful, not only is the patient relieved from the disturbances of anisometropia, but, in the presbyopic age, avoids the need for an extra pair of glasses.

A few cases may be cited. A grocer, aged 49 years, had three pairs of glasses, all unsatisfactory. His refraction was: R. —2.75 D. cyl. ax. 37°, 20/30; L. —11.00 D. sph. ⊂⊃ —2.50 D. cyl. ax. 157°, 20/30. In the prescription ordered, the right lens was unchanged, but for the left was prescribed —8.00 D. sph. ⊂⊃ —2.50 D. cyl. ax. 157°, with which he read 4 point at 13 inches. He could now read the scale and wait on customers efficiently. A salesman, aged 60 years, found reading difficult. Refraction: R. Plano, 20/15; L. —1.00 D. sph. ⊂⊃ —2.50 D. cyl. ax. 78°, 20/20. The prescription ordered, R. Plano; L. +2.00 D. sph. ⊂⊃ —2.50 D. cyl. ax. 78°, provided comfortable distant and near vision. A woman, aged 45 years, was unable to get suitable glasses. Refraction: R. —17.25 D. sph. ⊂⊃ —3.50 D. cyl. ax. 33°, 20/30; L. —13.75 D. sph. ⊂⊃ —2.75 D. cyl. ax. 158°, 20/30. For the right lens was ordered, instead —14.50 D. sph. ⊂⊃ —3.50 D. cyl. ax 33°. Myodisc lenses were advised, with the assurance that she would probably not need new glasses for many years. A merchant, aged 63 years, wanted only reading glasses. Refraction: R. +1.00 D. sph. ⊂⊃ +.50 D. cyl. ax. 175°, 20/25; L. +5.00 D. sph. ⊂⊃ +.75 D. cyl. ax. 120°, 20/50+. The "reading" glasses ordered were R. +4.00 D. sph. ⊂⊃ +.50 D. cyl. ax. 175°; L. as above. With this arrangement, he could look up from reading, and still have some, though blurred, distant vision.

These cases happened to have been in presbyopic subjects. In younger myopic individuals the procedure is just as advantageous. An insurance agent, aged 30 years, could not make out his reports without ocular suffering. Refraction: R. —1.50 D. sph. ⊂⊃ —2.00 D. cyl. ax. 8°, 20/20; L. —.25 D. sph. ⊂⊃ —.75 D. cyl. ax. 173°, 20/15; left hyperphoria of one-half prism diopter. In looking down 8 mm., the prismatic difference between the lenses was 2 prism diopters, base down, in the right eye, which accounted for his discomfort. The following prescription gave complete relief: R. —2.00 D. cyl. ax. 8°; L. as above, with half-diopter prism, base down. A woman singer, aged 36 years, found her glasses annoying and unsightly. They were, however, correct—R. —4.75 D. sph. ⊂⊃ +3.00 D. cyl. ax. 92°, 20/25; L. −2.25 D. sph. ⊂⊃ +3.50 D. cyl. ax. 67°, 20/20. Changing the right lens to —2.25 D. sph. ⊂⊃ +3.00 D. cyl. ax. 92° added to both her ocular ease and appearance.*

Anisometropia with monocular vision presents no difficulty. When it is optically immaterial what glass is worn over the amblyopic eye, esthetic considerations suggest that the lens approximately match that of the seeing eye. On this basis, older children as well as adults should be relieved of an unsightly correction

* Dr. Harry Shulruff, who assists me at Cook County Hospital, has successfully applied this idea to a case of troublesome vertical diplopia. A man, 53 years old, had diplopia after a skull fracture, due to paresis of the left inferior rectus. Refraction: R. —0.50 D. sph. ⊂⊃ —0.50 D. cyl. ax. 105°, 20/13; L. —0.25 D. sph. ⊂⊃ +0.50 D. cyl. ax. 80°, 20/13. Ordered: R. +2.00 D. sph. ⊂⊃ —0.50 D. cyl. ax. 105° (reads 3 point at 14 in.); L. unchanged.

over one eye from which no benefit is derived, whether squint is, or is not, present.

In presbyopia the weakened accommodation is associated with a weakened stimulus to convergence, and exophoria for near is consequently frequent. To maintain the range of near vision and not to aggravate an exophoria, the rule is to prescribe the weakest addition necessary. But cases must be individualized; the weak addition for one person may be too strong for another of the same age, and vice versa. Duane found a considerable variation in the amplitude of accommodation in normal individuals, the spread above and below his mean being 2 diopters at 45 years, 1 diopter at 50 years, and a half diopter at 55 years and over. A recent statistical analysis[5] indicates that women are affected with presbyopia earlier than men, the first reading glasses being obtained by most women at 43 years, by most men at 47. Hence, when a man of 42 states that he must read at arm's length, it is more likely that he is suffering from a diopter or more of uncorrected hyperopia, rather than from early presbyopia. A cycloplegic examination is indicated, and the approximately full correction should be prescribed.

These two quotations are apropos: One from J. Burdon-Cooper, "The highest exposition of the art of refraction is to write a prescription that secures comfort," the other from F. W. Dean, "All eye strain is muscle strain. A picture thrown on the retina from a near object does no more harm to the retina than one from afar."

58 East Washington Street.

References

[1] Pascal, J. I. Stereoscopic exercises in ametropia. Arch. of Ophth., 1933, v. 9, p. 952.
[2] Duane, A. Anisometropia. Arch. of Ophth., 1901, v. 30, p. 621.
[3] Boeder, P. Power and magnification properties of contact lenses. Arch. of Ophth., 1938, v. 19, p. 54.
[4] Von Rohr, M. Eyes and spectacles. London, Hatton Press, 1926.
[5] Collins, S. D., and Pennell, E. H. The use of the logistic curve to represent the prevalence of defective vision among persons of specific ages above thirty years. Human Biol., 1935, v. 7, p. 257.

NOTES, CASES, AND INSTRUMENTS

A CASE OF RETINAL ARTERIAL OCCLUSION WITH PARTIAL RECOVERY*

RALPH W. DANIELSON, M.D. AND JOHN C. LONG, M.D.

Denver, Colorado

Miss M. E., a university student aged 19 years, was examined on account of defective vision of the right eye of sudden onset. Her past personal history was irrelevant. A previous ocular examination had revealed no abnormality. The general health had been good except for fatigue.

The central vision of the two eyes was equal, 20/15. Visual-field studies showed a marked defect in the upper field of the right eye. In the inferior branch of the central retinal artery, about one-half disc diameter below the disc, was seen a yellowish area exactly continuous with the vessel and of the same caliber. On the distal side of this yellow area the artery continued in normal caliber but the blood was darker in color, having more the appearance of venous blood. Pressure on the globe produced pulsation in the artery proximal to the yellow area but no pulsation distally. On greater

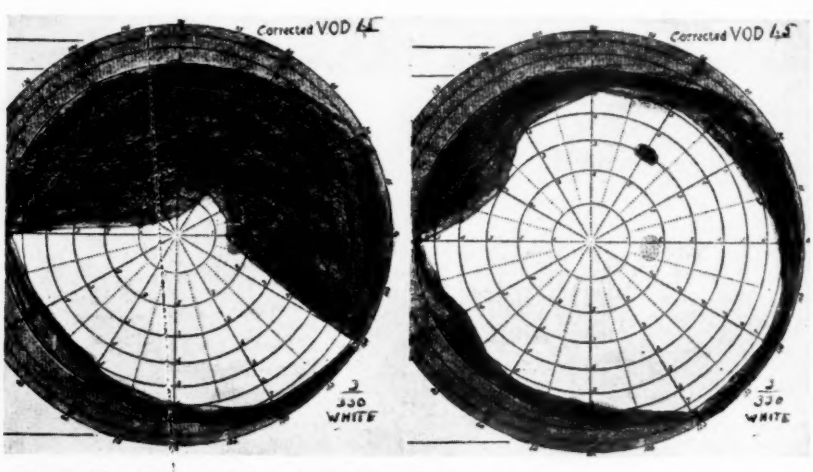


Fig. 1 (Danielson and Long). Field when first observed and three hours later, after use of massage and amyl nitrite.

On the morning of December 16, 1936, upon awakening, the patient noticed that the vision of the right eye was very poor. She assumed that the visual defect was due to sleeping with the fist pressing upon the eye. Vision became somewhat better after she was up and walking around, but did not clear up entirely. She was seen in the office at 11:30 a.m.

pressure the distal portion of the artery was emptied and on release of the pressure filled in a retrograde manner. There was slight edema of the retina in the area supplied by the vessel.

We assumed from these findings that the artery was completely obstructed by an embolic plug and efforts were made to drive the plug to a more peripheral site. Considerable pressure was made on the eyeball and then suddenly released.

* Read before the Western Ophthalmological Society, July 23, 1937.

This was repeated a number of times and during this massage the obstruction moved farther from the disc and after a transient pause lodged at a bifurcation. Further attempts at massage failed to dislodge the embolus. A pearl of amyl nitrite was administered by inhalation and during its administration the vigorous massage of the eyeball was continued. The obstruction suddenly moved far into the periphery, about five disc diameters from its original site. Within a few minutes the patient stated that the vision was gradually improving, and fields taken shortly afterward amply confirmed the improvement. We were unable to find the embolus the next day, but a slight amount of retinal edema persisted for at least four days.

We have reëxamined this girl several times over a period of one year. The fundus appears to be entirely normal. There remains a slight contraction of the upper field and a small relative scotoma above the blind spot. She is unaware of any visual difficulty.

Very thorough physical and laboratory examination by Dr. C. T. Burnett failed to show any probable source of the embolus. The heart appeared entirely normal after detailed study. The continued good health of the patient for the past year would further tend to eliminate endocarditis, or other usual embolic source. While not probable, local clot formation might have occurred from the stagnation resulting from long continued pressure on the globe. There was no evidence of damage to the vessel wall or of a pathological state of the blood to make local clot formation likely.

In this case the use of massage seems to have had a very definite effect. Pressure was applied gradually and then suddenly released. We are under the impression that the sudden release of the pressure is more important than its application. In fact, academically, it may be considered whether the sudden application of pressure might not force an obstruction toward the disc, as the caliber of the vessel increases in that direction.

We are cognizant of the experimental work of Lambert,[1] that would seem to show nitrites contraindicated, yet in our case the use of amyl nitrite apparently made it possible to dislodge the embolus from a bifurcation, after massage alone had been ineffective.

324 Metropolitan Building

CORNEAL REACTION TO WEED POLLEN

A. Reas Anneberg, M.D.
Carroll, Iowa

Since there is little in the literature on the lesions produced in the cornea by pollen, and since allergy in general, and of the eye in particular, is very interesting, the following six cases are reported.

The patients all came into the office within a period of four weeks during September, with the complaint of a sore eye following the cutting of weeds. All were farmers and, except for one man whose condition will be described later, the appearance and history were identical. The eye was painful, red, had a considerable itching sensation and hurt even when the lids were closed. There was the sensation of a foreign body in the eye. It was found upon examination that both the palpebral and bulbar conjunctivae were red. In the more severe cases there was an associated iris spasm with small pupil. There were no K.P. in any of the cases. The cornea at first showed no lesion, but two to four days after getting the weed pollen in the eye, grayish areas of infiltration appeared in the cornea.

[1] Lambert, R. K. Amer. Jour. of Ophth., 1935, v. 18, Nov., pp. 1003-1013.

These areas were from one-half to one millimeter in diameter, were raised above the surface of the cornea, and extended into the superficial layers of the corneal stroma. From the area of greatest density there was a gradual rapid diminution in the amount of infiltration to the normal cornea. At the height of reaction, from three to five days after the pollen entered the eye, there was a diffuse haziness and stippling of the whole cornea in two cases in which there was a greater number of the areas of dense infiltration as described above. At no stage in these cases was there any staining of the cornea with fluorescein. The reaction with the general corneal edema lasted about two to three days and then subsided. The spots of dense infiltration lasted from a week to 10 days longer, and there was no impairment of vision after recovery.

In investigating the type of weeds it was discovered in three cases that pigweed-redroot was predominent. The other three patients did not know what the weed was. It is doubtful whether this would necessarily be caused by the same pollen, but more probable that any pollen of the physical make-up of the pigweed pollen would produce the same picture. This weed was very profuse and pollenated very heavily in this community at the time these patients came into the office.

The one patient mentioned earlier was the exception to the other five. He was an allergic individual who had periodic flare-ups of contact dermatitis, due to weed poisoning. His eye reacted like the others and the condition was apparently subsiding until the seventh day when the area of infiltration, at the periphery of the cornea, at about the 2-o'clock position, broke down to form a marginal ulcer. The patient did not return between the third and sixth days, and during this time did not have the eye patched, as did all the other patients. It is believed that this and an admittedly allergic make-up were responsible for the developing ulcer. Healing of the ulcer was difficult; it became secondarily infected because of focal infection in the teeth, and healed only after the worst of these teeth were removed, and the ulcer had been cauterized with pure phenol three times.

The treatment which was used in the other five cases was as follows: the eye was patched after the instillation of butyn bichloride ointment. The two patients who showed edema of the cornea other than in the areas of dense infiltration received daily intramuscular injections of 10 c.c. of lactigen (Abbott) until the edema subsided.

SOCIETY PROCEEDINGS

Edited by Dr. H. Rommel Hildreth

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

April 20, 1937

Dr. Edwin B. Goodall, *presiding*

Some problems in ocular tuberculosis

Dr. Merrill King read a paper on this subject in which he reported the results of tuberculin tests in 1,350 patients who had chronic ocular disease clinically suggestive of tuberculosis. This paper will be published in detail elsewhere.

Dr. King said that the patients were given intracutaneous tests, using Saranac Old Tuberculin in graded dilutions. Seventy-two percent of these patients reacted positively to dilutions of the various dosages of tuberculin that were used. Many of the patients in the nonallergic group were repeatedly tested, but always with negative results. Eight patients, however, who were first insensitive to skin tests were found, after a period of from one to five years, to have become allergic. One negative skin test does not, therefore, definitely eliminate the possibility of a tuberculous etiology in chronic ocular disease.

A group of 238 patients had been given tuberculin treatments, or is still receiving such treatments. The ocular condition of many of these patients improved during the treatments; a smaller group of patients did not improve.

Dr. King concluded with a repetition of a statement that chronic ocular tuberculosis is very difficult to diagnose definitely. He believes that tuberculin is of value in confirming or eliminating a suspicion of a tuberculous etiology in chronic ocular disease. The majority of patients with chronic ocular tuberculosis are moderately or highly sensitive to tuberculin. Tuberculin therapy, if properly administered in selected cases of ocular tuberculosis, does no harm, and many patients under tuberculin treatment progress favorably. Dr. King urged that general clinicians, pathologists, and oculists expend more energy and coöperation to help advance our knowledge of chronic ocular tuberculosis.

Discussion. Dr. J. Herbert Waite said that no ophthalmologist with experience would oppose the speaker's conviction that an irrefutable clinical diagnosis of ocular tuberculosis is a difficult one to make. Ocular tuberculosis is encountered in the ratio of one to each thousand of pulmonary cases treated in institutions, and when found it is nearly always blood-borne and one of the terminal complications. The alert internist, when searching for demonstrable, active, somatic tuberculosis to account for the so-called ocular tuberculosis, seldom succeeds in his quest. In one tenth of these patients, more or less, there is X-ray evidence of calcified mesenteric lymph nodes, and in a much smaller number there is clinical or X-ray evidence of healed pulmonary tuberculosis. In the bulk of such cases, the evidence of tuberculosis as the cause of the ocular reaction is either fragmentary or nonexistent.

The trend of recent opinion about so-called ocular tuberculosis is that the ocular reactions represent local allergy rather than local infection. If the ocular reactions are truly allergic and not bacterial, then Koch's postulates become inapplicable in so far as the eye is concerned, and we must look to other methods not yet disclosed for certain identification of the clinical findings. It is questionable

whether we are justified in assuming that a skin test positive to tuberculin, without a simultaneous focal reaction in the eye itself, correctly identifies an ocular inflammation as tubercular. For the sake of diagnosis, it is scarcely permissible to expose an inflamed eye to the danger of a focal reaction, and to the danger of a massive tuberculosis.

Dr. Waite said the attempt to bestow immunity in tuberculosis through the use of tuberculin dates from 1890, when Koch tried to follow the brilliant lead of Behring and Kitasato in dealing with tetanus and diphtheria. Time has shown Koch to have been in error, and the therapeutic use of tuberculin has been outlawed the world over except in the field of ophthalmology, wherein there are two camps, the proponents and the opponents. It is beginning to be recognized that tuberculin, which may be toxic and dangerous in large doses, may bestow benefit in small doses through desensitizing the tissues already sensitized to tuberculo-protein by antecedent infection. Rich and McCordock voice the opinion that allergy and immunity in tuberculosis can be dissociated, and Friedenwald, after experimentation with animals, claims that loss of allergy to tuberculo-protein need not be associated with loss of immunity to tuberculosis. Dr. Waite said that Dr. King's work consisted of the intracutaneous injection in varying amount of Saranac O.T. in 1,450 patients with ocular inflammation, and from the 72 percent of positives the selection of 238 patients to receive tuberculin therapy. His method of applying tuberculin therapeutically utilized weekly, biweekly, and monthly injections, starting with an initial dose of one tenth the diagnostic dose, and increasing the dose gradually, but never using sufficient tuberculin to provoke a focal reaction in the eye. After five years' work, he reports no casualties, and he is convinced that the treated group as a whole has enjoyed better ocular health and more freedom from recurrence than the untreated group. Those of us who have observed Dr. King's careful work are happy to agree with his general conclusions. If any of us were afflicted with a recurrent ocular inflammation, labeled ocular tuberculosis after one or more positive reactions to intracutaneous tuberculin, we might also wish to know whether there were any evidence of general or of focal sepsis. Knowing that virus has selective affinity for tissues of ectodermal origin, brain, and eye, we might seek better methods of identification of virus inflammations of the eye. We would probably be unwilling to play the therapeutic tune on one string, the tuberculin string, but we would desire rest, proper diet, sunshine, and possibly the surgical removal of calcified lymph nodes if found.

Trygve Gundersen,
Reporter.

CHICAGO OPHTHALMOLOGICAL SOCIETY

December 20, 1937

Dr. Thomas D. Allen, *president*

Bilateral dacryoadenitis with involvement of right parotid and submaxillary glands (mikulicz's disease)

Dr. Martha Rubin Folk said that this patient, a woman, aged 23 years, came to the Dispensary in November, 1937. She complained of a dryness and swelling of the upper lids of both eyes which had been present for three weeks. The onset was sudden.

The lids were markedly edematous, almost covering the lower border of the pupil. There was slight sensitiveness on pressure over the lacrimal glands. The

right eye was slightly displaced downward and inward. When the upper lid was everted and the eye directed downward, the lower portion of the swollen gland came into view as a red, spindle-shaped nodular mass projecting into the conjunctival fornix in the superior temporal region. The bulbar conjunctiva was chemotic. The cornea was clear; the pupils were 4 mm. in diameter and reacted to light and accommodation; tactile tension was normal; the discs and fundi showed no pathology.

One week later the parotid and submaxillary glands became involved. General medical examination showed no abnormal findings, with the exception that the patient had a subacute rhinitis.

A smear from the palpebral conjunctiva showed upon culture the presence of Staphylococcus albus and aureus. Under treatment with bichloride ointment and potassium iodide, there was a great improvement. The glands became much smaller and softer. On December 15th, a buzzing sound developed in both ears, and the potassium iodide was discontinued. Upon her return to the clinic, two days later, the patient's lacrimal glands were slightly enlarged, but not so much as before.

Bilateral choked disc

Dr. Max Hirschfelder said that his patient, G. W., a man, aged 23 years, gave a history of diplopia and headaches for the past two months. Examination revealed a bilateral choked disc of five diopters in the right eye, two to three diopters in the left. There were small hemorrhages in the neighborhood of the papilla. The disc margins were markedly blurred. A very slight limitation of both upper temporal projection fields was demonstrated. Central vision was 20/25 in each eye. There was good perception for red in the central field, and marked enlargement of the blind spot. Grossly no paresis was evident. There was no evidence of intracranial pressure.

Laboratory examinations gave negative results with the exception of a leukocytosis of 12,000. Neurologic examination showed increased knee jerks on the left side. Babinsky and Oppenheim tests were positive on the left side. There was slight involvement of the glossopharyngeal, and a doubtful involvement of the right acustic nerve. Roentgenogram showed a slight erosion of the posterior part of the clinoid process.

Diagnosis: Intracranial tumor, probably in the angle between the pons and cerebellum of the left side. The possibility of a tumor behind the sella turcica exists.

Retained intraocular foreign bodies

Dr. Vernon M. Leech said that the two cases presented were important in that both men were entirely unaware that the eyes had been penetrated. Both accidents happened a number of years ago. The history in each case suggested the advisability of X-ray study of the orbit; an intraocular foreign body was found in each instance.

M. L., a man, aged 50 years, was first seen February 20, 1935, with a complaint of poor vision in the right eye. He stated that an optometrist had told him five years previously that he had glaucoma in this eye. Examination showed vision with glasses R.E. 20/200; L.E. 20/35 plus 3. Vision in the right eye could not be improved. Ophthalmoscopic examination of this eye showed a small hole about 0.5 mm. in diameter in the iris at the 9-o'clock position, midway between the pupil and the periphery. The fundus reflex was plainly seen through this opening. Slit-lamp examination showed a thin linear scar over this opening, about 2 mm. long, extending throughout the thickness of the

cornea. The visible portion of the lens showed no sign of foreign-body penetration. There was no evidence of inflammation. Fundus examination showed a deep glaucomatous cup and an irregular patch of choroidal atrophy, about two-thirds disc diameter in size, in the periphery of the lower temporal quadrant. Tension 65 mm. (Schiötz). The left eye was normal in all respects.

Upon further questioning a history of injury 11 years ago was obtained, when something struck the right eye while he was hammering. The eye did not become very red nor painful and seemed to be all right within a few days. Seven years ago he was struck in the right eye by a fragment of some kind as a truck passed him on the road. The eye remained red for two weeks.

X-ray report from Dr. Hollis E. Potter showed a small intraocular foreign body lying in or adjacent to the sclera in the lower temporal quadrant. Localization tests were not made as the patient had a slight tremor and the intensity of the shadow was so low that it was doubtful if it could be seen through the dense bony tissue.

The unilateral glaucoma was probably due to a low-grade uveitis, developing after the accident, which produced a secondary glaucoma.

O. B., a man, aged 35 years, was seen first in December, 1937, with a complaint of poor vision in the left eye. Examination showed vision R.E. 20/25 plus 3; L.E. 20/100 plus 1. Under homatropine, a lens over the right eye improved vision to 20/15. No glass was accepted for the left eye, but vision was improved to 20/35, because the pupil was dilated beyond the area of central-lens clouding. Slitlamp examination of the left eye showed a beginning cataracta complicata with slight posterior subcapsular changes centrally located and a few vacuoles in the superficial part of the anterior cortex. The fundus showed, immediately below and adjacent to the optic disc, a mass of what appeared to be organized exudate, oval at its base, about two-thirds disc diameter in size, and extending forward, somewhat cone-shaped, four or five diopters into the vitreous. The optic disc was somewhat blurred in its lower half. Otherwise the fundus appeared normal.

Twelve years previously, while chiseling steel, a piece broke off and struck his left eye, causing it to remain slightly sore for several months. No X-ray pictures were obtained. He was not told that anything had penetrated the eyeball and did not know whether the doctor knew it or not.

X-ray report from Dr. Potter showed a small intraocular foreign body imbedded in the sclera of the lower inner quadrant, adjacent to the optic disc.

These cases demonstrate the diagnostic value of careful history taking and X-ray study. Both patients were warned as to possible future danger of sympathetic ophthalmia, but as both eyes in each case were quiet, no surgical interference was indicated. The diagnosis of intraocular foreign body even at this late date is of importance in considering the possibility of future surgery. In the first case, one would want to know that an intraocular foreign body was present before attempting to relieve the intraocular tension; and in the second case, the question of cataract extraction might arise.

Severe metastatic complications of acquired syphilis

Dr. Paul Hurwitz stated that this man, H. R., aged 63 years, was first seen at the dermatologic clinic of Central Free Dispensary in September, 1937. He gave a history of having acquired a genital lesion in July, 1937, for which a dusting powder was prescribed. In August, fol-

lowing the discovery of a four-plus Kahn test, antisyphilitic treatment was given; he received five intravenous injections. Until November 3d he was given seven weekly doses of 0.45 gm. neoarsphenamine and one injection of bismuth. A lapse of six weeks occurred before the patient reappeared. He was then referred to the eye clinic because of an ocular complication.

The pertinent complaints consisted of redness and sharp pains of the right eye, marked diminution of vision in this eye, and photophobia associated with severe right frontal and temporal headache. Examination showed corrected vision to be R.E. 20/200 and no Jaeger, L.E. 20/25 plus 3. The findings were confined to the right eye. There was marked tenderness, especially of the nasal portion. The palpebral conjunctival surfaces were slightly injected. There was slight ciliary injection of the temporal side of the bulb and a very deep mixed injection of the nasal portion. The nasal bulbar conjunctivae including the plica were swollen. Though the cornea appeared clear macroscopically, the slitlamp revealed numerous small round, grayish, posterior corneal precipitates especially in the lower half. The cell content in the anterior chamber was increased, and cells seemed to be fixed. The iris was not discolored and the iris pattern was distinct. There was a very fine posterior synechia below. The pupils were 3 mm. in size, and reacted sluggishly to light. The anterior lens capsule showed numerous pigmented and nonpigmented precipitates. An accidental finding was a bilateral perinuclear cataract. The vitreous was clouded by dustlike opacities. The disc and a large portion of the adjoining retina were edematous; there was marked venous congestion, the veins being obscured where the coils of the vessels dipped into the edematous retina. The macular region was hazy. Over the entire nasal portion of the fundus, where the retina was edematous, there were numerous scattered, deeply situated, various-sized and -shaped, bright-red retinal hemorrhages. Tension was 15 mm. Hg in each eye.

The central field of the right eye showed an enlarged spot, a small absolute paracentral scotoma, surrounded by a relative scotoma of 15 degrees radius. The peripheral field showed a moderate irregular contraction of the temporal visual field and a marked concentric constriction for red. The left fields were within normal limits.

Diagnosis: Right papillitis, iridocyclitis, and scleritis on a syphilitic basis. This case presents a severe and relatively uncommon complication of acquired syphilis; namely, a double metastatic lesion of the right eye: one metastasis to the bulbar portion of the optic nerve and another to the sclera and by contiguity involving the adjacent choroid and uvea. It was thought that the severity was due to the age of the patient and his low immunologic response, the complication occurring despite comparatively early institution of treatment.

Problems encountered in cataract surgery

Dr. Watson W. Gailey read a paper on this subject which was published in this Journal (August, 1938).

Discussion. Dr. William A. Fisher said that Dr. Gailey's arbitrary blood pressure of 185 appeared rather high; blood should be taken away if the pressure is more than 170, or even less, as advocated by Elschnig. While gloves are very important so far as the nurse is concerned, the operator need not wear them if he does not touch the eye except with instruments. He thanked Dr. Gailey for his reference to the Fisher needle, which he himself, however, had discarded some years ago; it

was designed for use in the Smith operation, and that technique is used now only in the presence of complications. While helpful in removing the lens, the needle has been found to rupture too many capsules. If there is proper anethesia, if the lid is kept away from the eyeball during the operation, a good operator will secure average good results. The question is, how can that technique be obtained?

In his own practice he uses a full iridectomy in all cases, instills atropine the night before and the morning of the operation, and the lens is removed within its capsule, without complications; it is not necessary to disturb it for four days. He had contracted that habit in India because there, as soon as the patient knows he can see he discharges himself. Smith and Holland therefore leave the bandages on until they are sure of the result.

He felt that, although he had used all kinds of capsule forceps, he had had better results with the sucker. It is not necessary to make pressure on the lens, as it adheres without pressure. Pressure on the lens favors its dislocation. In 1932 he had described a method for becoming proficient in the use of the sucker by using chicken lenses. They must be freshly killed chickens. The eyes are removed, the lenses are placed in a little mask made from a spool, and practice by this method will insure an excellent technique. Many surgeons are afraid of this method because they fear they will suck out the vitreous. The technique once mastered, is not difficult, and the complications are less than when the operation is performed with capsule forceps. An intracapsular cataract operation without complications is considered ideal.

Dr. Harry Woodruff asked what procedure Dr. Gailey would follow with a patient who had lost one eye from an intraocular hemorrhage, when it became necessary to operate on the second eye.

The Credé method of preventing ophthalmia neonatorum calls for the instillation of silver nitrate. Why would not this procedure, 12 hours before operation, prevent any infection.

He believed the speculum should be discarded. It is no longer necessary and is a dangerous instrument.

Dr. W. W. Gailey (closing) said that he had not been aware of the fact that Dr. Fisher had discarded his needle. He presumed this was because he had not been hampered with broken capsules since using the erisiphake. It is possible to suck up the contents of the globe with a sucker. One should not apply the erisiphake without determining in advance the presence or absence of a sticky fluid on the anterior surface of the lens. In some instances the lens has been dislocated during the incision, permitting vitreous to seep into the anterior chamber. It is possible to exert enough pressure with the fixation forceps to dislocate the lens before the eye is opened. The test for the presence of vitreous on the anterior surface of the crystalline lens is important when the erisiphake is used.

In reply to Dr. Woodruff's question concerning introcular hemorrhages, he had tw such cases now awaiting operation. His first procedure would be to reduce the arterial tension well below the normal limit for the age of the patient. He would use retrobulbar injections of novocaine without adrenalin, and perform a combined extraction, avoiding all unnecessary manipulation. Sedatives would be administered prior to operation and perhaps for one week afterward.

A 2-percent solution of silver nitrate is used routinely by some men before cataract extraction.

He had tried the use of lid hooks as well as sutures to retract the lids during

operation, and was not satisfied. After some years of experimentation he had returned to the use of the speculum and had not regretted it.

Report of a case of spontaneous extrusion of an intraocular foreign body (shot) with recovery of vision

Dr. Harry W. Woodruff read a paper on this subject which was published in this Journal (September, 1938).

Discussion. Dr. Dwight C. Orcutt wished to report a case similar to that of Dr. Woodruff. About 20 years ago a patient was observed who had been injured in a hunting accident. The shot lodged in almost the same line as that described by Dr. Woodruff, through the globe into the sclera on the opposite side. The report on the X ray was very ominous, and it was thought the eye would have to be enucleated. Three or four days later the patient appeared unannounced, and the shot was extracted from the opposite side of the eye. For some time he retained vision of 20/40, which gradually lowered. The lens was not injured.

The value of routine examinations of the eyes

Dr. Thomas D. Allen read a paper on this subject which was published in this Journal (October, 1938).

Discussion. Dr. William A. Fisher said that those men who were most successful in medicine were those who routinely carried out a systematic examination. Dr. Woodruff's report was proof of this—while Dr. Woodruff called it luck, the luck was with the patient who secured him for a doctor.

Robert von der Heydt

COLLEGE OF PHYSICIANS OF PHILADELPHIA

Section on Ophthalmology

December 16, 1937

Dr. Charles R. Heed, *chairman*

Intracapsular cataract extraction

Dr. Leighton F. Appleman said this is the third report upon the results of intracapsular extraction in a series of 250 uncomplicated and 18 complicated ward cases, and upon 72 private cases seen between March, 1935, and November, 1937.

Analysis showed that of the 250 uncomplicated ward patients, 146 (58.4 percent) were operated on by the intracapsular method, and vision of 6/12 or better was obtained in 98 (67.1 percent) of the group.

Of 72 private cases in which the intracapsular method was used, 63 (87.5 percent) obtained vision of 6/12 or better.

A review of the visual results in the three series of personally operated-upon patients since he began the use of the intracapsular method, reveals the following data: the 1932 report showed 67.02 percent received vision of 6/12 or better; the 1935 report showed 77 percent received vision of 6/12 or better; in the present series 87.5 percent received vision of 6/12 or better.

Discussion. Dr. Robb McDonald stated that he and Dr. Cowan were interested in the changes in the anterior segment of the eye as examined under the slitlamp, and changes in visual acuity several years after the operation. In all, 750 patients were written to who had had cataract operations at the Wills Hospital during the period 1933-1935. All cases of traumatic and complicated cataract and cataract associated with glaucoma or patients known to have lesions in the posterior segment of the eye were excluded from the series. The response from the patients

was poor and they had examined only 156 aphakic eyes. This included a slitlamp examination and refraction.

Their findings, when they have investigated a further series of cases, will be reported in full, and more definite conclusions can be arrived at, but for the present they were of the opinion that: (1) Following intracapsular cataract extractions, for the first few weeks the hyaloid membrane bulges forward into the anterior chamber, later it becomes flatter and does not protrude through the pupillary space. In many cases there is a rent in the hyaloid membrane, with a subsequent herniation of vitreous into the anterior chamber. In cases of this kind, examination showed that it did not appear to affect the vision. (2) In the aphakic eyes examined after intracapsular extractions, no changes were found in the hyaloid membrane suggestive of increasing density of the membrane or of its becoming less transparent. In fact in most cases the visual acuity was the same or better than that found on the original refraction. (3) An incision that is limbal throughout gives a nicer healing scar than one that is farther forward in the cornea.

In those patients upon whom a preliminary iridectomy had been performed, there were far fewer incarcerations of the pillars or anterior or posterior synechia (in intracapsular extractions) of one or both pillars. (4) The appearance of the capsule in extracapsular extractions is no index of what the visual acuity may be. In many cases, examination under the slitlamp showed the pupillary space to be filled with clusters of Elschnig bodies and strands of opaque capsule, yet on refraction nearly normal or normal vision was obtainable. (5) So far in their investigation they had found those eyes having intracapsular extractions have slightly better vision than those having extracapsular extractions.

Dr. Edward Bedrossian reported that of the five medical mission hospitals in India where he served as associate ophthalmologist last year, in two hospitals the intracapsular method of cataract extraction is used routinely.

The first problem is the selection of proper cases for this type of operation. All juvenile cataracts, exopthalmic eyes called ox eyes in India, cataracts complicated with uveitis, synechiae, discoloration or ectasis of the sclera, and cataracts with glaucoma are excluded.

Secondary glaucoma due to hypermature cataract is extremely common. Many patients are totally blind in both eyes on account of hypermature cataract with absolute glaucoma.

In Lalitpur, U.P., they employ Sir Henry Holland's technique with the addition of O'Brien's method of orbicularis paralysis. Tension of all eyes is taken routinely on the operating table, twice with the Schiötz tonometer, and if tension is found to be above 25 mm. Hg, the case is considered unsuitable for intracapsular extraction. From 10 to 50 cataract patients report daily for operation, so there still are plenty of cases for intracapsular extraction.

After limbal incision and the usual iridectomy, the eyelid speculum is removed, and the patient is told to look straight up. The upper lid is lifted away from the eyeball by a broad lid elevator, and held in this position by the assistant. While the patient looks straight up, the eyeball is steadied with a small oval spatula applied below the limbus, and the zonule is broken at the lower limbus by gentle stroking with the Smith hook. This made the lens tumble and come out without the use or aid of the capsule forceps. Occasional vitreous loss was due to the patient's looking down instead of straight up during the extraction of the lens or toilet of the wound. When the extracted lens jammed

in the upper fornix, it was easily removed with a small spoon or spatula. After repositing the pillars of the iris and toilet of the wound, the eye is dressed with wet bichloride dressing.

In Coinbatore, South India, Dr. S. Qurubatham has developed a very complicated and elaborate technique of his own quite different from that just described. Routinely, he gives pontocaine 1:500 injections into the orbicularis and into the ciliary ganglion. Adrenalin is injected subconjunctivally: he dilates the pupil with homatropine, puts superior-rectus suture to rotate the eyeball downward, and the assistant holds it in the most desirable position throughout the operation. He finishes his limbal incision with a small conjunctival flap. If the lens and vitreous move forward toward the incision, he forms a flap suture before extraction. He breaks the zonule with the Smith hook at the lower limbus, and then with his own special capsule forceps pulls the lens out with great care through the intact pupil. After replacing the iris and making a careful toilet of the wound, he reflects the conjunctival flap backward, and with a Barraquer iris forceps and iris scissors makes a small peripheral iridectomy. Peripheral iridectomy after simple extraction checks the danger of postoperative iris prolapse into the incision.

His handling of the eye is so masterly and gentle that there is hardly any traumatism. On the third day, when the dressing is changed and the eye inspected, one sees a rapidly healing wound in perfect apposition, and a perfectly clear round pupil.

Dr. George Cross said that in May, 1929, he started operating on cataract by the intracapsular method, using the Knapp-Török-Stanculeanu technique. He is still using the method and is quite enthusiastic about it. It is routine for him to perform a peripheral buttonhole iridectomy for many reasons. He believes the reason why many operators do not do this is because of the difficulty in grasping the iris properly. This is overcome by the use of the Hess forceps.

Loss of vitreous can be at times avoided by the use of more pull and less push in rupturing the zonule and tending to preserve the hyaloid membrane.

Retrobulbar or muscle-cone injection with novocaine is of great value to him. After the visit of Dr. Arruga to Dr. Shannon's Clinic at Jefferson Hospital he purchased his speculum and has been suturing the superior rectus tightly to the hook on the upper bar, and so far he is greatly pleased with the results obtained.

He still believes the younger operators should perfect the extracapsular technique first, and when proficient select cases for special methods.

Dr. Appleman said the delivery of the lens by pressure or traction can be done with equal facility by individual operators who are experienced. One must by quick judgment determine which is best to pursue in the given case.

Regarding the use of a cotton-wrapped applicator in cleansing the debris from the site of operation, it is preferable to moisten it very slightly before use in order to prevent loose strands becoming entangled in the wound and inducing or favoring secondary infection during healing.

As to the iridectomy, the small peripheral one is all that is necessary for safe delivery of the lens.

Simple extraction, without iridectomy, has been disappointing to him because of the frequency of incarceration of a knuckle of iris in the wound following the operation.

Bilateral superficial lesions of the cornea due to allergy

Dr. George J. Dublin presented the

case of a white woman, aged 48 years, who complained that her eyes had been inflamed and painful for the past week. She had had a similar attack four years ago.

Vision in each eye was 6/6. Both eyes showed moderate bulbar injection; the cornea contained from 50 to 200 punctate infiltrates in the epithelium; the infiltrates were thickened and slightly elevated, and stained with fluorescein. The eyegrounds were normal.

Medical examination disclosed slight sinus pathology, and secondary anemia. The sinus condition cleared, but pain and discomfort continued in spite of the usual treatment. Allergic tests were made, and the patient was found strongly plus four to orris root, and negative to all other tests.

Treatment consisted of changing her cosmetics to a nonallergic brand. Relief was instantaneous, and within twenty-four hours there were only five staining areas in right cornea, and twenty in the left cornea, whereas there had always been approximately 100 to 200 staining areas in each cornea for the past four months. She was seen frequently for three months and no recurrence took place.

Discussion. Dr. William Zentmayer also saw this patient and at that time the conjunctiva and upper lid were quite papillary, and there was vascularity of the limbus together with the change in the cornea described by Dr. Dublin. The condition resembled trachoma somewhat, and he thought this possibility should be borne in mind although there was also a likelihood that it could be due to cosmetics. He believes Dr. Dublin has conclusively shown that the latter was correct.

Dr. Leighton F. Appleman believes observations of this kind to be of considerable importance. Occasionally we all see, in hospital practice, cases of inflammation involving the lids and conjunctiva which resist all our usual forms of medication. He had at times been at a loss to know what medication to use next.

A. G. Fewell,
Clerk.

SAINT LOUIS OPHTHALMIC SOCIETY

November 26, 1937

DR. LAWRENCE T. POST, *president*

CORNEAL TRANSPLANTS

DR. WILLIAM M. JAMES read a paper on this subject which will be published in this Journal.

Discussion. Dr. Meyer Wiener said Dr. James failed to mention the first successful trephining transplant by Zirn in 1893. He also failed to mention another done by Von Hippel. Dr. Wiener had attended a course given by Castroviejo and saw the pictures of his patients before and after operations. His impression was that 80 percent of the cases in which he did a through-and-through trephining could have acquired as good or better results with corneal resection. Filatov has removed corneae of stillborn infants successfully. The technique of operating on animals is most difficult. One difficulty, that of fixation, is overcome by stay sutures. The greatest handicap is anesthesia. He believes that Dr. James deserves credit for giving us the failures as well as his successes with animal transplants, because we only learn through failures. He believed that most of the cases where the corneal opacity is due to injury from caustics, such as lime or carbide (or any case where the cornea has no posterior synechia) are more successfully treated with corneal resection than by corneal transplant. We cannot expect to get good results where there is vascularity in corneal resection. The same thing should hold

good in corneal transplant. If we used either radium or X ray, we would have a clearer cornea than we would by not using it. We are indebted to the Drs. Hilgartner of Texas for suggesting the use of radium to keep down vascularization.

Dr. James said the question of the vascularity of the cornea was most distressing. On the seventh postoperative day the vessels were in the upper margin of the transplant. X-ray treatment was suggested in repeated small doses, but was not given after the problem had been discussed with members of the X-ray department. The difficulty of handling Descemet's membrane will remain in all full-thickness grafts, because there is no tendency toward healing in this structure.

Application of certain results of research to the glaucoma problem

Dr. William H. Luedde read a paper on this subject which will be published in this Journal.

Spontaneous rupture of lens capsule with healing

Dr. E. C. Spitze said that J. C., a coal miner, was first examined August 15, 1937. He had received an injury to the right eye by a piece of coal in 1930. This eye had been inflamed for the past four days, according to the patient. There was marked congestion of the entire globe, catarrhal conjunctivitis with seromucous discharge. The cornea was clear, the lens opaque. Metaphen was prescribed and five days later the inflammation continued. The tension measured 55 mm. (Bailliart). Eserine sulphate was prescribed. On August 20th a small rupture of the anterior lens capsule was seen in the 8-o'clock position. There was a drop of clouded lens substance in the anterior chamber. The tension improved and on October 30th examination with a Coddington lens showed only a faint scar of the lens capsule at the site of the rupture. The corneal microscope showed a finely granular appearance of the scar, which was very small. A search of the literature failed to reveal a similar case.

Dr. Spitze said that Bakkar of the University of Gröningen, Germany, in experiments with rabbits' eyes reports that when the lens capsule is injured a small floccule of lens substance escapes. The two capsule edges are curled outward. In a few days the lens substance is absorbed and the wound in the capsule is filled with a mass of cells. These elongated cells lie parallel to the surface of the lens. The cell nuclei are spindle shaped and can hardly be distinguished from young fibroblasts. The mass of newly formed cells gives the appearance of newly formed connective tissue. In the next few weeks the nuclei vanish and leave the lamellar membrane which bridges the defect in the capsule. In the meantime a new capsule is formed with the end result of a very faint scar.

Discussion. Dr. Meyer Wiener said the case of Dr. Spitze's is most unusual in that there is healing after a spontaneous rupture of the capsule of the lens. He had never seen one in which a spontaneous rupture of the capsule, with glaucoma, had healed.

H. Rommel Hildreth,
Editor.

AMERICAN JOURNAL OF OPHTHALMOLOGY

Published Monthly by the Ophthalmic Publishing Company

EDITORIAL STAFF

LAWRENCE T. POST, *Editor*
640 S. Kingshighway, Saint Louis

WILLIAM H. CRISP, *Consulting Editor*
530 Metropolitan Building, Denver

EDWARD JACKSON, *Consulting Editor*
Republic Building, Denver

HANS BARKAN
Stanford University Hospital, San Francisco

HARRY S. GRADLE
58 East Washington Street, Chicago

H. ROMMEL HILDRETH
824 Metropolitan Building, Saint Louis

PARK LEWIS
454 Franklin Building, Buffalo

C. S. O'BRIEN
The State University of Iowa, College of Medicine, Iowa City

M. URIBE TRONCOSO
500 West End Avenue, New York

*JOHN M. WHEELER
635 West 165th Street, New York

EMMA S. BUSS, *Manuscript Editor*
6820 Delmar Boulevard, Saint Louis

Directors: EDWARD JACKSON, President, LAWRENCE T. POST, Vice-President, DR. F. E. WOODRUFF, Secretary and Treasurer, WILLIAM L. BENEDICT, WILLIAM H. CRISP, HARRY S. GRADLE.

Address original papers, other scientific communications including correspondence, also books for review and reports of society proceedings to *Dr. Lawrence T. Post, 640 S. Kingshighway, Saint Louis.*

Exchange copies of medical journals should be sent to *Dr. William H. Crisp, 530 Metropolitan Building, Denver.*

Subscriptions, applications for single copies, notices of change of address, and communications with reference to advertising should be addressed to the *Manager of Subscriptions and Advertising, 640 S. Kingshighway, Saint Louis.* Copy of advertisements must be sent to the manager by the fifteenth of the month preceding its appearance.

Author's proofs should be corrected and returned within forty-eight hours to the *manuscript editor.* Twenty-five reprints of each article will be supplied to the author without charge. Additional reprints may be obtained from the printer, the George Banta Publishing Company, 450-458 Ahnaip Street, Menasha, Wisconsin, if ordered at the time proofs are returned. But reprints to contain colored plates must be ordered when the article is accepted.

SPECTACLES OLD AND NEW

In the minds of a few of our patients, spectacles seem almost to be regarded as in the nature of a curse inflicted by some malign influence upon suffering humanity. Yet, as a matter of fact, the possibilities opened up by these simple and insignificant pieces of glass represent one of the greatest blessings ever conferred by successive discovery and invention.

Think of the gap that would exist in the lives of most elderly persons if correcting lenses were unobtainable; or of the suffering from eyestrain which would accompany the efforts of hyperopic, astigmatic, or even mildly anisometropic patients to meet the needs and requirements of modern life without spectacles; or of the youthful students whose careers would be thwarted and warped by defective or difficult vision.

The antiquity of spectacle lenses has been much discussed. The fusing of siliceous mixtures to form glass dates back at least to the time of Babylon the wicked, but there is no very satisfactory evidence to suggest that convex or concave lenses were fabricated before the thirteenth century.

Roger Bacon, Franciscan excommunicated by the Pope for his scientific writings, seems to have made lenses for studying the stars and also for the investigation of details otherwise too minute for the human eye.

The invention of spectacles by Salvino degli Armati, Italian banker of the thirteenth century, has been vigorously controverted by Armati's compatriots. Armati apparently happened to be in the

* Deceased.

vicinity of Venice about the time when spectacles were first made there, but the name of the actual inventor will probably never be known. A curious rule of the ancient trade guilds forbade disclosures of the names of inventors. It is possible that medieval glass makers of Venice, who were already familiar with the making of magnifying lenses, took the further step of setting spectacle lenses before both eyes by means of a frame.

The records made by Marco Polo, one of the earliest of European travelers in China, credited the Chinese with using spectacle lenses before 1260 A.D. Such lenses were made of native rock crystal. Burning glasses are mentioned as having been used in China long before the Christian era. Rakusen of Shanghai (Chinese Medical Journal, 1938, volume 53, page 379) quotes various references to the early Chinese use of rock-crystal lenses for therapeutic purposes (by concentration of the sun's rays), but he does not believe that the ancient Chinese ever used glass in the manufacture of spectacles. The earliest known lense is said to be a plano-convex one of rock crystal, found in the ruins of old Nineveh by Sir Henry Layard. It measured from 1.4 to 1.6 inches in diameter, was 0.2 inch thick, and had a focal length of 4 inches, or about 10-diopter strength.

Although Nero has often been credited with using a concave emerald through which he viewed the gladiatorial contests, it is probable that concave lenses were practically unknown until early in the sixteenth century. An oil painting of Pope Leo X (1475 to 1521), who was very nearsighted, shows him holding a single round glass in his left hand, and the concavity of this glass is plainly depicted by the image of the reflection. In spite of some claims to the contrary, it is generally conceded that spectacles were probably introduced into China from Europe.

Reference has frequently been made to the pioneer work of Thomas Young the physicist (and physician) and of George B. Airy the mathematician in describing and correcting astigmatism. It is interesting to recall, as mentioned by Ida Mann (Transactions Ophthalmological Society of the United Kingdom, 1938, volume 58, part one, page 109), that in 1801 Young described a simple lens apparatus which he called the hydrodiascope, with which, when it was filled with water and applied to the cornea, he was able to abolish the corneal astigmatism of his own eye.

Spectacle lenses were at first biconvex or biconcave. The first improvement was effected by the use of plano-convex and plano-concave forms. The later meniscus (convexo-concave) lens was for a long time popular in what was known as a "periscopic" lens, having a 1.25-diopter base curve. At the present time the vast majority of all spectacle lenses have a much deeper base curve than had the "periscopic." The term "toric" has been applied to many such lenses, and may perhaps for practical purposes be defined as representing a modification of the deep meniscus in which one surface carries an astigmatic curvature.

In lenses used for photographic and other optical purposes various improvements have been introduced for the elimination of types of aberration. Thus the best modern photographic lenses are made so as to give, on a flat field, sharp definition to the very edges of both lens and film, with absence of spherical and chromatic aberration. Spectacle lenses are subject to spherical and chromatic aberration and also to the astigmatism of oblique pencils of light rays.

In the eye, itself an imperfect optical instrument, the brain has learned to ignore these aberrations, at least in great part, and their avoidance in the spectacle lens is perhaps much less important than some

people would lead us to suppose. As regards the astigmatism of oblique pencils it has been pointed out quite frequently that exact vision seldom demands more than 10 degrees of ocular rotation. Beyond that angle of rotation turning of the head is almost always resorted to.

In a lecture before the 1938 meeting of the Ophthalmological Society of the United Kingdom "On the development of spectacles, with special reference to recent improvements" (see the Transactions, 1938, volume 58, part one, page 359), Rohr emphasizes the fact (mentioned repeatedly by Cowan and others) that it is practically impossible to produce for commercial distribution lenses which would eliminate all the types of aberration above mentioned.

For the past quarter of a century various large manufacturers of spectacle lenses have undertaken to produce, more or less along the lines of analytical formulae calculated by Tscherning in 1899, lenses relatively free from the astigmatism of oblique pencils of rays. The curvatures of such lenses must be calculated in relation to the center of rotation of the eyeball, which is commonly about 13 millimeters behind the vertex of the cornea.

Cowan (Archives of Ophthalmology, 1929, volume 2, page 322; also 1934, volume 11, page 611; and elsewhere), while admitting that the lenses thus calculated are often good, has taken some manufacturers and dealers to task for their exaggerated claims of perfection. Particularly open to criticism is the claim that these lenses are at the same time accurate at the vertex and free from both astigmatic and spherical error over an angle of 60 degrees. Cowan further calls attention to the fact that in the majority of cases these special types of lenses have no greater practical value than meniscus or toric lenses ground on a six-diopter base curve.

Most use of the eyes from which appreciable eyestrain may arise depends upon the exercise of foveal vision in approximately direct forward gaze. The older types of lens were often as comfortable to the patient as the newer styles. Most people nowadays have learned to feel old-fashioned in a flat lens, and as to the lenses of deep curvature the American national habit of keeping abreast of the times often favors rather easy acceptance of a more expensive lens than is really necessary, because the salesman represents that he is offering the latest improvement; and in such a case the purchaser may fail to receive substantial value for the additional expense. A similar statement might be made regarding spectacle frames.

Usually more important than the precise manufacturer's model, and too frequently overlooked, are the exact height and the spacing of the lenses in relation to each other and to the patient's eyes. Many a patient has failed to obtain satisfaction from bifocal lenses, for no other reason than that they had been inadequately explained to him and had been set too low, with the mistaken idea that he ought to be able to look over them easily in glancing at the floor. Other mistakes include "dishing" (or failure to set both lenses in a single plane), inadequate or on the other hand occasionally exaggerated tilting of strong lenses for downward vision, and the use of very large lenses with a base curve so deep that the orbital rim prevents adequate approximation of the vertex to the eye.

The German poet, Goethe, and the English diarist, Pepys, the former myopic, the latter hyperopic, both nourished prejudices against the wearing of glasses. Goethe was probably too much of a fop, while Pepys had apparently been told that if he wore glasses he would go blind that much faster. These and other prejudices are still common. In sensible people they

should be outweighed by the practical advantages conferred. But vogue has a part in the wearing of refractive corrections, as well as in matters of dress and cosmetics, wedding and funeral styles, the furnishing of houses, and even the fine arts.

Most emphatically to be aimed at are the accurate grinding and fitting of corrections which have been prescribed upon the basis of skillful and painstaking measurement of refractive errors.

W. H. Crisp.

COMPARATIVE PHYSIOLOGY OF ACCOMMODATION

Vision is such an important function for the great mass of animals, and can be so well studied through the control it exercises on movements and habits, that it may be broadly considered with regard to comparative anatomy and physiology. From such studies we have learned that perception of light and many of its variations is common to all animals that have powers of independent locomotion. Such vision has been attained through widely varied optical adjustments of the visual organs. Between the eyes of vertebrate and invertebrate animals no connecting link is yet known. Invertebrate eyes present a wide variety of optical plans all differing greatly from the general plan of the vertebrate eye.

The refraction of the vertebrate eye is accomplished by the cornea and crystalline lens, and changes in the lens give the power of accommodation. In some fish the lens can be pulled back from the cornea, closer to the retina, in this way adapting the eye to more distant vision. In birds and some reptiles the iris is rigid, and by pushing the lens forward the anterior surface is made to bulge more in the area of the pupil, thus accommodating the eye for nearer vision. In mammals, by changing the tension on the suspensory ligament and capsule of the lens, the softer, more superficial portions of the lens are forced toward the anterior and posterior poles, causing greater convexity of the lens in the area of the pupil. It is certain that some birds see distinctly very small objects, close to their eyes, and that other birds recognize relatively small objects at great distances. But about the accommodations of birds little is known. It is a field for investigation that may yield important scientific results.

The mammals living on the surface of the earth need good distance vision. To see where food is to be obtained, and to avoid their enemies, they need a large peripheral field of vision and ability to detect movements in it. With these powers of vision they are able to catch their prey, or escape their enemies. Most of them have no macular nor binocular vision. Those living in trees, as the squirrels and monkeys, have need of binocular vision to judge distances when jumping from branch to branch. Some of the cat family need near vision for seizing their prey. For 70 years the matter of accommodation in the lower animals has been a matter of study and experiment by skilled investigators. But the definitely established facts as to accommodation are few, and mainly of negative importance. At first it was assumed that the eyes of lower animals had accommodation, like that of the human eye. This is not generally the case. The eyes of wild animals are mostly hyperopic; among domesticated animals there occur instances of myopia of high degree. But it appears that only in monkeys is there evidence of much accommodation. The eyes of squirrels seem not to have been studied with reference to their accommodative power.

In the British Journal of Ophthalmology for March, 1938, Sir James Barrett, of Melbourne, Australia, has published an

article on "Accommodation in the eyes of mammals." Soon after the introduction of "retinoscopy," he, with Mr. Lang, of London, applied retinoscopy for testing the refraction of the eyes of lower animals. He now reviews the literature of the subject and quotes, with approval, the summary of Professor Osborne, of Melbourne, giving eight different plans for accommodation in the eyes of lower animals. In conclusion Barrett confesses himself ignorant and, he is afraid, will remain ignorant. But facts are facts, all of them capable of destroying falsehood and correcting error. The field is still open and inviting to future investigators. But Barrett's question as to what good small amounts of accommodation can be to animals possessing them, tends to negative hope that mammals, in general, have accommodation akin to that of the human eye.

Edward Jackson.

THE ACADEMY MEETING AT WASHINGTON

Glancing over the editorial comments on past meetings of the Academy, the striking feature is that each meeting has been thought the best of all. The fact is that this has been approximately accurate. New features have been added yearly; not all of them have been accepted as permanent additions, but a goodly number have stood the test and have contributed to make bigger and better Academy meetings. There is, no doubt, danger from too many activities. As one member stated, "We have a three-ring circus now. Let's not make it five rings!"

There is no denying, however, that this Washington meeting was one of our best: big attendance, good programs, splendid courses—the newer continuity type have become increasingly popular, and deservedly so. The banquet was as fine as usual. Especially entertaining was the postprandial lecture, which, informative and interesting, occasioned enthusiastic comments from the audience. The other evening of diversion on the following night was also more than usually amusing. We saw some of our well-known members' wits put to the test of a "Major Bowes" quiz about other members. The trick was very cleverly handled by the representatives of the Philip Morris Cigarette Co., who generously sponsored the show and, as our genial president remarked, "it was worth walking a mile to see!" The skit was written by some smart lad from our membership who preserved his anonymity. Credit to him for his contribution to the stunt.

There is, however, a just criticism of this sort of thing for the Academy. There was a good deal of tobacco in evidence. Granted we haven't the money to put on a show like that with a fine orchestra, but isn't sponsorship by a commercial company a little undignified, to say the least? Aren't we by implication sponsoring the sponsor? True enough, our activities are becoming more costly each year and to finance our protean activities is increasingly difficult. But there is a more direct and obvious method to care for this added cost, and that is by an increase in dues to members who have been in practice for 10 years or more. This would avoid hurt to the recent graduate, and if only a small increase were made it would scarcely be felt by the older members and would take care of the rising costs of Academy activities—temporarily, at least.

The teachers meeting brought forth two concrete recommendations to the Council: one for the formation of a committee of two members from each Board and three members from the Academy to investigate and report on available residencies in ophthalmology; and the other for the appointment of a committee to consider the organization of correspondence courses under the sponsorship of the

Academy. The former idea was contributed by Dr. Wherry and the latter by Dr. Gradle. Both give promise of being extremely valuable.

The Academy went on record as urging Congress to appropriate the $2,750,000 already authorized for construction of a new Army Medical Museum and a Surgeon Generals' Library to replace the old buildings. We increase our tie-up with the Army Medical Museum each year. The organization under Colonel Ash is most coöperative. On the average two eyes a day are sectioned and studied, as well as much ear, nose, and throat material. There are over 6,000 specimens in the eye pathology section alone.

The following officers were elected for the coming year: Dr. George M. Coates, Philadelphia, president; Dr. Albert C. Snell, Rochester, New York, president-elect; Drs. William W. Pearson, Des Moines, Iowa, William J. Mellinger, Santa Barbara, California, and Charles A. Bahn, New Orleans, vice presidents. Dr. William P. Wherry, Omaha, Nebraska, was again chosen executive secretary-treasurer, and Dr. Second H. Large, Cleveland, comptroller. Dr. Carl M. McCaskey, Indianapolis, was elected a member of the council, and Dr. Grady E. Clay, Atlanta, to represent the Academy on the American Board of Ophthalmology. It was decided to hold the 1939 meeting at Chicago.

Thanks to our Washington hosts for their cordial coöperation and many courtesies.

Lawrence T. Post.

BOOK NOTICES

DAS TRACHOM. Ergänzungsband. By Prof. Dr. A. Peters. 85 pages. Basel & Leipsig, S. Karger, 1938.

This is a monograph intended as a supplementary volume to a textbook of trachoma published by the author in 1935. The present publication is in the form of a review of the literature pertaining to trachoma and covering the period from November, 1934, to February, 1938. For convenience, the different reports are classified under history, clinical aspects, optical aids in diagnosis, histology, the causative agent and the inclusion body, transmissibility, prophylaxis and control, geographical distribution, therapy, and nonoperative management. Each topic summarizes from 60 to 100 references, thus bringing together about 600 communications.

While the supplement is obviously comprehensive and complete, it performs essentially the function of a collective abstract unbenefited by analysis or critique on the part of the author. It is consequently difficult to review this monograph. As an index and abstract summarization of the literature on trachoma, published during the period mentioned, it is a valuable compilation to the student of this disease.

L. A. Julianelle.

AUGENAERZTLICHE EINGRIFFE, eine kurzgefasste Operationslehre (Ophthalmic surgery, a brief textbook of operations). Edited by Prof. Dr. J. Meller, Chief of the First University Eye Clinic in Vienna. Fourth revised and enlarged edition, with contributions by J. Böck, K. Kofler, A. Pillat, and L. Sallmann. Paper covers, 416 pages, with 261, partly colored, reproductions in the text and on two plates. Vienna, Verlag von Julius Springer, 1938. Price RM 36, bound RM 37.80.

The appearance of this fourth edition is an event of importance in medical literature, even though the opportunity of reading the volume may be limited to readers of German.

It had previously been the purpose of the author in chief to limit his descriptions

to such operative procedures as were in use in his own clinic. Hence some very important omissions from the first three German editions.

These defects (for such they must have appeared to many ophthalmologists) have now been remedied. While Meller himself has apparently never seen his way to resort to the use of iridencleisis, that operation is here very adequately described and discussed by Pillat. It is noteworthy that, whereas some American workers consider it advantageous to instill homatropine before performing the operation, Pillat still resorts to several instillations of a 1-percent solution of pilocarpine as a part of the patient's preparation upon the operating table.

Pillat recommends what he regards as an important modification of Holth's original technique of iridencleisis. After the meridional incision of the iris, the forceps grasping the iris are pulled toward the corresponding angle of the scleral wound. "If the scleral incision on the one hand was not too large and on the other hand oblique enough, then the other part of the iris also is left lying in the scleral wound." Pillat's reason for this is that he has not infrequently had the experience of finding in 24 hours that the incarcerated iris had slipped back into the anterior chamber. He further urges that the forceps shall not open more than two millimeters in grasping the iris before its withdrawal, and that the meridional incision shall not extend to the root of the iris.

When Meller's third edition appeared in 1931, the operative techniques for retinal detachment were still in course of development. Now that electrocoagulation has manifestly conquered the field, a special chapter is devoted to the subject. Meller's assistant Böck discusses localization of the tear, and the operative technique for barrage of the tear by electrocoagulation; while Sallmann describes Lindner's undermining method.

Kofler adds a description of the technique of endonasal dacryocystorhinostomy.

The mechanical details of the new edition, both as to text and as to illustrations, are beyond criticism.

W. H. Crisp.

THE ETIOLOGY OF TRACHOMA. By Louis A. Julianelle, Ph.D. Clothbound, 248 pages, 10 plates (3 in color). New York, The Commonwealth Fund; London, Humphrey Milford, Oxford University Press, 1938. Price $3.25.

Having served seven years as director of research on trachoma, conducted in the Oscar Johnson Institute at Washington University, under a liberal grant by the Commonwealth Foundation, the author is well qualified to write as an authority on this subject. He and his co-workers have made many notable contributions toward developing the now inescapable evidence that the etiologic agent of this world-wide scourge is a virus. In this monograph the history of the age-old search for the agent is traced, and the progress towards the final conclusion is outlined step by step.

The first chapter outlines briefly the clinical manifestation and usual course of the infection. Thereafter the diseases which have a marked similarity—such as, inclusion blennorrhea, swimming-bath conjunctivitis, folliculosis, pemphigus, and vernal catarrh—are described and differentiated clinically. Biological manifestations and histologic pictures of trachoma are then described.

From the frequency of the finding of inclusion bodies in the epithelium it is logical to believe that the source of infection is from the surface of the conjunctiva.

In the author's laboratory extensive experiments on the nutrition of trachomatous individuals and the influence of mal-

nutrition on the infectivity of trachoma in monkeys were made. These showed a complete lack of any such relationship, ruling out the contention that many workers had advanced; namely, that trachoma is a disease of malnutrition.

Chapter two deals with general considerations of epidemiology. Such factors as climate, race, age, and individual susceptibility are discussed. The apparent resistance of the full-blooded American Negro to the disease is interesting.

Obviously a matter of great importance in determining the etiology is its experimental transmissibility to man. Through the years there have been relatively few recorded attempts. This history has been considered here in detail. In 108 experiments dating as far back as 120 years ago, there have been 73 successes; that is, 68 percent. Accidental transmissions have been very suggestive, as by nurses, wrestlers, and others. The incubation period seems to be from 7 to 10 days.

The experimental transmission to apes and monkeys is next reviewed, and all known reports are condensed and presented in a table. The percentage of successes is 40. That this is less than the percentage from human experimental transmissions is not surprising, as the ape is relatively resistant to the virus.

General considerations of infectivity and the microörganisms associated with trachoma are taken up in the next chapter. The one that attracted most attention was B. granulosis, because of the reputation of its exponent, Noguchi. It was regrettable that he himself did not live to rule out this bacillus, as he would probably have done by further experiments.

The microscopic feature of trachoma that has excited the greatest interest has been the inclusion bodies of Halberstaedter and Prowazek. They and their biologic cycle are minutely described as well as their history. Two beautiful colored plates illustrate this chapter.

The next chapter considers the relation of viruses to trachoma. Much of the infectivity of filtrates depends on the character of the filters used. Detailed observations on the results of various workers with different filters are given.

Purification of the virus by passage through rabbits' testicles and otherwise is possible, but no method of growing the virus has been found. Tissue cultures have frequently been tried but have always failed.

The author's conclusions in part are that ". . . the infectious agent of trachoma is characterized by low infectivity, occasional filterability, marked tissue specialization, ineffectual immunogenic properties, slight propagative capacity, and sensitivity to deleterious agents. The infection it causes is accompanied by inclusion bodies which are composed of heterogeneous elements, for the most part basophilic, differing, therefore, from the homogeneous acidophilic inclusions more frequently encountered in virus diseases. At times, however, the inclusion, still heterogeneous, may be more uniform and display distinct acidophilic tendencies suggesting the elementary-body formation of certain viruses. All these properties suggest the probability that the infectious agent is a virus."

Forty-five pages of bibliography and seven pages of index bear witness to the care that has been given to the compilation of this book. There are excellent colored illustrations, half tones, and photomicrographs. This is an outstanding monograph.

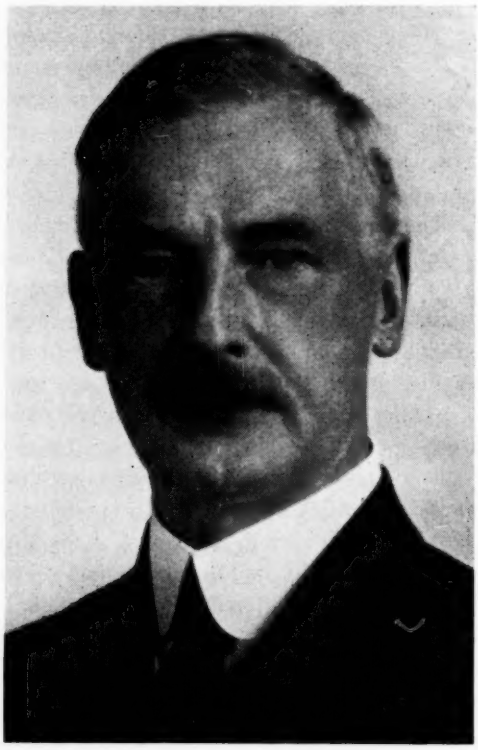
Lawrence T. Post.

OBITUARY

GEORGE E. DE SCHWEINITZ
1858-1938

During his long professional life George Edmund de Schweinitz was a fine example of an American ophthalmologist. He

was born in Philadelphia, October 26, 1858, and died there August 22, 1938. His father stood high in the Moravian Church, and he studied in the Moravian College at Bethlehem, Pennsylvania, where he took



George E. de Schweinitz

the degrees of A.B. and A.M. in 1876. He studied medicine at the University of Pennsylvania, and received the degree of M.D. in 1881. In 1881 to 1883 he served as interne in the University Hospital, and in the Children's Hospital.

For three years he was prosector to Prof. Joseph Leidy, professor of anatomy and eminent biologist. He also taught therapeutics for five years in the Medical Institute of Philadelphia, a quiz organization. But he was also interested in ophthalmology, working in the out-patient clinic of the university, and in the clinic of S. Weir Mitchell at the Orthopedic Hospital and Infirmary for Nervous Diseases. In Dr. Mitchell's clinic he worked with William Osler, who suggested to him in May, 1887, that he write a book on the eye for medical students and medical practitioners. The book was written and published in 1892. It was reprinted twice in the next year. Its immediate success was due to his fitness for the task, shown in the amount and selection of what it contained, and to the literary excellence of the writing. The latter he credited to his stepmother, whom he spoke of as the "literary editor." This book held its leading position through five reprints and ten editions, because the author rewrote and brought each edition fully up to date. When a new edition was called for he turned aside from his usual work and gave the necessary time to additions, rewriting, and revision of proofs. In noting valuable additions to the literature, he carefully gave the names of the authors. Courtesy and desire to do full justice to others was an outstanding feature in all that Dr. de Schweinitz did. It reflected his personal character.

His interest in ophthalmology was first manifested by his service in the out-patient eye clinic of the University Hospital. When he was made lecturer on Medical Ophthalmoscopy, in the general course in medicine, he brought to the attention of medical students the physiology of the eye, and the value of the ophthalmoscope in medical diagnosis. In 1891 he was made Professor of Ophthalmology in the Philadelphia Polyclinic, later the Graduate School of the University. In 1892 he became Clinical Professor, and later Professor of Ophthalmology in the Jefferson Medical College. In 1902 following the death of Professor Norris, he was made Professor of Ophthalmology in the University of Pennsylvania. In 1914 the University conferred on him the degree of LL.D.

Dr. de Schweinitz early began to write out reports of his cases, and published some of them in the University Medical

Magazine, and in other medical journals. He became a Fellow of the College of Physicians of Philadelphia, and its president in 1910. He took an active interest in establishing its Section on Ophthalmology. He was made ophthalmologist to the Orthopedic Hospital, and vice-president of the Pennsylvania Institution for instruction of the Blind. In the World War he was a major in the Medical Reserve Corps, and in active service from September 29, 1917, to April 1, 1919, mostly in Washington, but for several months in France. He had charge of instruction courses, and was on the editorial board for the Medical and Surgical History of the War. He was later made a brigadier general.

With Dr. B. Alexander Randall, Dr. de Schweinitz was author of a treatise on "Diseases of the eye, ear, nose and throat." He was American editor of the works of Professor Haab: Ophthalmoscopy, External diseases of the eye, and Operative ophthalmology. He joined in editing the Ophthalmic Year Book, 1905 to 1909. He gave the Bowman Lecture on "Ocular aspects, especially field defects of pituitary body disorders," in 1923. In 1924 he addressed the Société Française d'Ophtalmologie, on "Ocular interpretations of focal infections." When the International Congress on Ophthalmology was held at Washington, D.C., in 1922 Dr. de Schweinitz was its president. The gathering was such a success that it led to the Congress of English Speaking Ophthalmologists at London in 1925; and the revival of the International Congress of Ophthalmology which had been interrupted by the war.

The literary activity, accuracy of statement, and conscientious fidelity to truth were shown in all that Dr. de Schweinitz wrote. The first year he undertook to assist with the year book, he wrote a full half of the digest of the literature; and only gave this up as others were ready to take his place. President Wilson was his patient for years, and President Hoover congratulated him on the award of the Dana Medal in 1930. The University of Michigan and Harvard University gave him the degree of LL.D., and Moravian College the degree of L.H.D. In spite of his busy practice he contributed papers to societies and journals every year, many of them to general medical journals. Perhaps his most important original contribution to ophthalmology was his work on "Toxic amblyopias," for which he received the Alvarenga Prize in 1894. In the Section on Ophthalmology in 1891 he read a paper first calling attention to the frequency of astigmatism "against the rule," in patients over 50. That year he was made secretary of the Section, and in 1896 chairman. In the American Ophthalmological Society he was made vice-president in 1915 and president in 1916. In the College of Physicians of Philadelphia he was made president in 1910, after serving it well in other capacities. In the University of Pennsylvania, after he retired from teaching, he was a member of its Board of Trustees, and chairman of its Medical Committee. Throughout his professional life, George E. de Schweinitz kept the respect, the trust, the admiration of all who knew him.

Edward Jackson.

ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is only mentioned in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

5
CONJUNCTIVA

Martinez, E. S. **Treatment of the complications of trachoma by autohemotherapy (subconjunctival route).** New contribution. Rev. Internat. du Trachome, 1938, v. 15, April, p. 87.

The author compares the apparent immunity of many in trachomatous districts with that found in tuberculosis. He thinks that the immunity is acquired by many very slight infections rather than that it is a natural immunity. He further compares trachoma with other chronic affections that are benefited by an intercurrent acute illness. The organism becomes habituated to the chronic disease and does not react sufficiently to overcome it. Consequently the application of a factor that will increase the defense reaction might cure the chronic disease. Such a factor is autohemotherapy. First the patient's own blood was injected intramuscularly, but the reaction obtained was insufficient. By injecting the blood conjunctivally the defensive reaction was more intense and more efficacious. The injection is made in the upper cul-de-sac. There is very little edema following the injection. Autohemotherapy is particularly efficacious in the torpid ulcers and pannus of trachoma, and has also been used with good effect in hypopion from the pneumococcus.

J. Wesley McKinney.

Montgomery, P. W. **Lupus erythematosus of the conjunctiva.** Arch. of Dermatol. and Syphil., 1938, v. 37, March, pp. 417-418.

A case of lupus erythematosus of the conjunctiva is reported in which a woman had an irritable conjunctivitis, obstinate to local treatment, associated with spots of erythema scattered down the middle of the face. Both the conjunctival and the skin lesions cleared when treated with sodium gold thiosulfate.

T. E. Sanders.

Ruedemann, A. D. **A micro-camera for visualization of conjunctival vessels.** Trans. Amer. Ophth. Soc., 1937, v. 35, p. 419.

A rather complicated apparatus for visualizing and photographing the fine conjunctival vessels and capillaries is described. It has been the author's purpose to study these vessels in known pathological states with a view to re-

cording vascular changes which may later be useful for clinical and comparative studies.

David. O. Harrington.

Toulant. **Attenuated trachoma.** Rev. Internat. du Trachome, 1938, April, v. 15, p. 65.

The author describes a form of trachoma in which the signs and symptoms are barely perceptible. It is difficult to diagnose but nevertheless an important entity. In its usual form there are no granulations or other visible lymphoid reaction. The conjunctiva is very slightly injected and little thickened and there is only slight pannus and corneal infiltration. Symptoms are minimal. This form responds well to simple treatment but recurrences are common. Trauma, superimposed infection, or lowered resistance may cause development of the severe type of trachoma. J. Wesley McKinney.

Werner, Sigurd. **A case of subconjunctival epithelial cyst and trachoma.** Acta Ophth., 1938, v. 16, pts. 2-3, p. 304.

A cyst excised from the lower lid, in a case of healed trachoma, was found on microscopic examination to have a many-layered epithelial lining. This feature, according to the author, indicates that the origin of the cyst was an adhesion between two folds of trachomatous conjunctiva.

Ray K. Daily.

Youmans, J. B., Corlette, M. B., Corlette, M. G., and Frank, H. **Inadequacy of conjunctival smears in the diagnosis of slight vitamin-A deficiency in adults.** Jour. Laboratory and Clin. Med., 1938, v. 23, April, p. 663.

Examination of smears from the bulbar conjunctivas of normal subjects and nine patients, before and after the administration of vitamin A in large doses, revealed large numbers of cornified epithelial cells. Great variations were noted in successive smears and in the smears from each eye. No consistent difference was noted after administration of vitamin A. The presence of even large numbers of cornified cells in smears from the conjunctiva cannot alone be taken as evidence of early vitamin-A deficiency in adults. (7 references.) Ralph W. Danielson.

6

CORNEA AND SCLERA

Böck, J. **Icteric discoloration of the cornea.** Graefe's Arch., 1938, v. 138, pt. 6, pp. 790-797.

Macroscopic examination of the cornea of humans with jaundice frequently discloses a greenish stain in the peripheral parts of the cornea, especially when viewed against a blue or gray iris. With the slitlamp, the author discovered that the stain involved almost the entire thickness of the cornea. Toward the corneal center the stain became fainter and the superficial layers were less colored than the deep ones. The center of the cornea is always free from stain. With dimunition of the jaundice, the discoloration of the cornea also grows less. H. D. Lamb.

Castroviejo, R. **Keratoplasty—microscopic study of the corneal grafts.** Trans. Amer. Ophth. Soc., 1937, v. 35, p. 355.

Clinical and microscopic studies of corneal grafts show that the transparent graft retains its individuality and preserves its own cellular elements. Causes of nebulosity and opacification of the graft are: (1) poor coaptation of margins with the cornea of the host; (2) post-operative infection; (3) incarceration of intraocular structures;

(4) vascularization of the graft. In human beings the graft becomes opaque if entirely surrounded by dense scar tissue. Heterotransplants almost invariably become opaque. Corneal sutures are more satisfactory than a conjunctival flap in holding the transplant in place. The literature of the subject is reviewed. David O. Harrington.

Dellaporta, N. **A remarkable case of marginal dystrophy of the cornea.** Klin. M. f. Augenh., 1938, v. 100, June, p. 915.

A man aged 56 years had received a blow from a rope on his left eye five years earlier, causing plastic iridocyclitis complicated by chronic glaucoma. Both corneas presented at the upper periphery an opaque zone consisting of yellowish-gray dots and ectasias. There was an anterior synechia of the iris, probably a sequel of the plastic iridocyclitis, as no perforation of the cornea had occurred. The affection was apparently due to primary degeneration of the corneal tissue. C. Zimmermann.

Epstein, E., and Chambers, S. O. **Keratosis blenorrhagica with corneal lesions.** Arch. Dermat. and Syphil., 1937, v. 36, Nov., p. 1044.

The authors present two male patients, 22 and 31 years of age, who were successfully treated for keratitis blennorrhagica by artificial fever therapy. The lesions in the eye began as deep papules or vesicles which reached the surface and became eroded in 24 to 48 hours. There were pain and photophobia. Theodore M. Shapira.

Friede, Reinhard. **Cases of penetrating optical keratoplasty.** Klin. M. f. Augenh., 1938, v. 100, July, p. 1.

Friede reports on a total material of 78 cases. With increasing technical skill the final results became better. From 1921 to 1929, he obtained 18 percent clear and 31 percent translucent healed-in flaps; from 1930 to 1938, 52 percent clear, 19 percent translucent, and 29 percent opaque. Failures were due to the fact that formerly, too frequently, total leucomas were operated upon. Limitation to central scars with clear marginal zones was very successful. The indication for the operation, the kind of donor material, the preparation of donor and receiver, and other important points are discussed in detail. Autoplasty gave the best results. Clear healing-in of flaps from the eyes of cadavers was twenty percent more frequent than from enucleated eyes. (Illustrated.) C. Zimmermann.

Ješe, L. **Further contributions to keratitis nummularis.** Klin. M. f. Augenh., 1938, v. 100, June, p. 874.

In 1936 (see Amer. Jour. Ophth., 1936, v. 19, p. 728), Ješe reported 77 cases of keratitis nummularis up to July, 1935; and until July, 1937, 47 cases came under treatment, in 33 men and 14 women. These are described in detail. The affection commenced spontaneously in all patients, the majority coming from agricultural districts. Fifteen percent ascribed the origin to an injury. Morphologically the disease belongs to the herpetic affections of the cornea. Before the World War it was unknown, but in the last few years it occurred almost epidemically similar to the frequency of herpetic corneal affections in those regions. It cannot be influenced therapeutically. Scarification of the foci with subsequent application of tincture of iodine, iodoform salve, and A vitamins, had no noticeable effect. C. Zimmermann.

Nižetić, Zdravko. **Attempted kerotoplasty in an infant whose cornea sloughed through blennorrhea.** Klin. M. f. Augenh., 1938, v. 100, July, p. 32.

After placing sutures through the conjunctiva above and below, the remaining portion of the cornea was trephined with the hand trephine of the author, Graefe's knife creating the bed for the transplant. The bulging lens and the prolapsed piece of iris were removed and the lids sewed together, as there was no other possibility of fixation. Thus total sloughing of the cornea and loss of the contents of the eye were arrested. After about two weeks the central parts of the flaps were opaque. The further events will be reported later. (Illustrated.)

C. Zimmermann.

Sagher, E. **Primary ribbon-shaped degeneration of the cornea.** Klin. M. f. Augenh., 1938, v. 100, June, p. 891.

In a woman of 27 years the ribbon-shaped opacity had existed since puberty but had lately become more intense. The eyes were not irritated, V.R. 6/6, L. 6/8. The right cornea showed striated irregular opacities in the superficial parenchyma and a small circular opacity in Descemet's membrane, with a cystic bulging toward the anterior chamber. The left cornea presented a ribbon-shaped opacity of 4 mm., leaving a free interval of only 1 mm. between limbus and opacity; and there were small dense nodular opacities in Descemet's membrane. No etiology could be found. The formation of cysts in Descemet's membrane suggested disturbances of metabolism, perhaps of endocrine nature, as etiological factors. The designation of primary ribbon-shaped corneal degeneration ought to be limited to cases in which no ocular causes can be found.

C. Zimmermann.

Schmidt, Martin. **The nature and development of the keratoconus lines.** Klin. M. f. Augenh., 1938, v. 101, July, p. 36.

Four cases are reported. Briefly eliminating them by increase of intraocular tension through compression of the globe, abdominal pressure, and so on, the author was able to prove that the keratoconus lines were folds in the parenchyma next to Descemet's membrane. They are corrugation folds and are caused by the contrasting force of the elastic lamina of the cornea in the overlying stroma. Their direction lies in the meridian of greatest tension and resistance against the progressing stretching, that is, in the meridian of greatest curvature. Opacities at the apex are influenced by the insertion of contact glasses. Systematic use of contact glasses not only restores the impaired vision for the time being, but seems to be a very important orthopedic remedy. (Illustrated.)

C. Zimmermann.

Wolff, Herbert. **Ulcer of the cornea and A-avitaminosis.** Acta Ophth., 1938, v. 16, pts. 2-3, p. 323.

A report of a case. The diagnosis is based on the therapeutic response and on the presence of a hemeralopia, fluctuating with the state of the corneal involvement. The author reviews the literature on A-avitaminosis, and points out that the deficiency may be caused not only by an insufficient supply of vitamin A, but also by disturbed fat metabolism, which interferes with vitamin assimilation. In such cases the needed vitamin should be administered intramuscularly. Ray K. Daily.

7

UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Aaron, F., and Zeeman, W. P. C. **Atypical coloboma and spontaneous cyst of the iris.** Acta Ophth., 1938, v. 16, pts. 2-3, p. 308.

A six-months-old girl had the left eye enucleated with the diagnosis of pseudoglioma. The microscopic examination revealed the presence of a large cyst in the iris, situated between the stroma and the posterior layer. It filled the anterior and posterior chambers and displaced the lens backward and temporally. In the pigment epithelium over the posterior wall of the cyst was a narrow slit. In this slit the cyst wall was free, and to it were attached abnormally placed zonular fibers. The insertion of the zonular fibers into the epithelium of the iris leads the author to conclude that the cyst had originated from the everted inner wall of the secondary optic cup. (Illustrations.)

Ray K. Daily.

Lagrange, H., and Goulesque, J. **Iridocyclitis and focal infection.** Ann. d'Ocul., 1938, v. 175, July, pp. 493-507.

Three cases of iridocyclitis are reported. Two patients had syphilis but did not improve on antisyphilitic therapy. All three had disease of the nasal accessory sinuses and all three improved promptly after sinus surgery. The "reflex" theory of ocular inflammation from foci of infection supposes that disease of sinuses or teeth on the same side of the face affects the trigeminal nerve. From this a reflex action on the vegetative nervous system of the eye prepares the uveal tract to receive bacteria from the blood stream. This reflex may be interrupted by novocaine block along the nerves. Such a theory does not explain uveitis from focal infection on the other side of the head or elsewhere in the body. Brief reference is made to the literature on the bacteria involved and the question of blood-borne infection. Probably the focus acts as a sensitizing agent which produces an allergic reaction in the reticulo-endothelial structure of the uvea.

John M. McLean.

Lijo Pavia, J. **Greenish spots in the fundus and general diseases.** Rev. Oto-Neuro-Oft., 1938, v. 13, Jan., p. 10.

Repetition of article published in December issue of same journal (see Amer. Jour. Ophth., 1938, v. 21, p. 578). The repetition carries a plate including six fundus photographs in color.

Lisch, Karl. **Polycoria.** Klin. M. f. Augenh., 1938, v. 100, June, p. 896.

A man of 39 years complained of impairment of vision, which was due to nuclear opacities of the lenses. The scleras were slightly bluish and each eye showed moderate microcornea, while the right eye had two, and the left eye three, pupils lined by sphincters. There was intense hypoplasia of the stroma of the iris, as well as translucent fine gray glassy deposits at the periphery of the posterior wall of the cornea, resembling the embryotoxon corneae posterius of Axenfeld, and to opposite points of which the sphincter was adherent. The pupils reacted promptly to light, and also responded to homatropine and pilocarpine. The polycoria and the other changes are attributed to disturbances of mesodermal development.

C. Zimmermann.

8

GLAUCOMA AND OCULAR TENSION

Bentsen, K. G., Dalsgaard-Nielsen, E., and Möller, H. U. **Ophthalmic symp-**

toms of Sturge-Weber's disease. Acta Ophth., 1938, v. 16, pts. 2-3, p. 279.

A review of the literature on this syndrome, characterized by the presence of nevus flammeus, glaucoma, and epileptiform convulsions. The author reports three cases to show that the ocular symptoms of this disease are not limited to buphthalmia and glaucoma. One had nevus flammeus, homonymous hemianopsia, and epilepsy; the second nevus flammeus, vascular disturbances of the conjunctiva and retina, hemianopsia, and imbecility; and the third nevi, glaucoma, total ophthalmoplegia of the left eye, internal ophthalmoplegia of the right eye, and disturbances of the central nervous system. The ocular symptoms frequently indicate the location of cerebral angiomas. When the angioma of the involved cortical area can be removed, recovery from the cerebral symptoms becomes possible, and one of the author's cases was thus relieved of the epileptiform convulsions. Ray K. Daily.

Kirwan, E. O'G., and Mukerjee, S. N. **The osmotic pressure of the aqueous humor in epidemic dropsy.** Brit. Jour. Ophth., 1938, v. 22, June, pp. 329-336.

The article follows Kirwan's demonstration in 1934 of the relationship between epidemic dropsy and glaucoma (see Amer. Jour. Ophth., 1934, v. 17, p. 1184). The present objective is to show whether in epidemic dropsy the same conditions maintain as in other instances of altered permeability of capillaries or whether the toxin is responsible for maladjustment of equilibrium between blood and aqueous humor in some way independent of the membrane hypothesis. The osmotic pressures of aqueous humor in normal eyes and in cases of glaucoma associated with epidemic dropsy were investigated.

There are three theories as to the causation of epidemic dropsy: (1) that it may be due to rice infected with certain bacteria; (2) that infection due to personal contact may be a factor; (3) that mustard oil is a conveyor of some harmful substance. The authors maintain that the fact that the anterior chamber, under high tensions, is rarely shallow but is normal or deeper than normal, as pointed out by Kirwan in 1934, is clinical proof that swelling of the vitreous body cannot be the cause of the chronic glaucoma. This is in disagreement with Duke-Elder, Davson, and Benham (see Amer. Jour. Ophth., 1936, v. 19, p. 1137.)

The authors' conclusions are: that disappearance of the proteins from the serum and their appearance in the aqueous reduces the difference of osmotic pressure in epidemic dropsy; that a new equilibrium due to increase of chlorine ions in the serum with decrease in the aqueous is established; and that investigations lend support to the theory that in the glaucoma of epidemic dropsy the filtration of fluid into the anterior chamber occurs by the usual process of dialyzation, the difference in equilibrium as compared with normal cases being due to altered permeability of the dialyzing membrane. (Formulas, tables, references.)

D. F. Harbridge.

Pereira, R. F. **Opticociliary neurotomy.** Arch. de Oft. de Buenos Aires, 1938, v. 13, Jan., p. 1.

The historical phase of opticociliary neurotomy from the time of Graefe is outlined. Technique and complications of the operative procedure are discussed. Pereira states that the operation is indicated in cases of painful absolute glaucoma where enucleation would customarily be performed, and also in

phthisis bulbi when a prothesis is to be worn over the eye and there is no danger of sympathetic ophthalmia. The operation does not protect against the development of sympathetic ophthalmia, although, according to the author, Czermak advocates its employment if the patient refuses enucleation. A single case report is included.

Edward B. Burch.

Pickard, Ranson. **The photochromatic interval in glaucoma and cavernous atrophy.** Brit. Jour. Ophth., 1938, v. 22, July, pp. 391-400.

The author offers a test relative to the photochromatic interval which it is hoped will prove helpful in the early stages of glaucoma. The "p.c.i." (photochromatic interval) is produced by brightening or enlarging an area stimulated with a color sensation at a fixed point, or by movement in the field from without inward to the point of fixation. A light stimulus is produced but not a color stimulus. The system of light used in the test is described, using transmitted and not reflected colors. For clinical investigation the red disc only was used, as the change from white to red is more recognizable than that of white to blue or yellow. The 10-mm. disc was employed with the cases demonstrated, which were consecutive and not selective, since they came for examination without arrangement. Findings are based on cases of glaucoma and cavernous atrophy without nervous or cerebral involvement, it being stated that there would seem to be need for further tests where there is known to be nerve interruption.

The size or absence of the photochromatic interval as demonstrated in the cases studied is fully discussed and is presented in tables, it being noted that the p.c.i. in the glaucoma group is absent or slight in all but three studies, while in the cavernous-atrophy group it is present and large in all but four, with one of the four showing the red field to be normal. In glaucoma it must be assumed that pressure quickly obliterates the liminal subchromatic red sensation in any part of the retina, with the cases of exception showing a greater resistance, while in the cavernous-atrophy group there is a large p.c.i., exceptions here also being noted. The author feels the tests worthy of further investigation. (Tables.)

D. F. Harbridge.

Schoenberg, M. J. **New developments in the pharmacological treatment of primary glaucoma.** Brit. Jour. Ophth., 1938, v. 22, July, pp. 417-425.

This contribution has a two-fold purpose: (1) to present some ideas relative to the action of sympathomimetics (Sy-Mi) and parasympathomimetics (Pa-Sy-Mi) in normal and glaucomatous eyes; (2) to suggest investigations still needed to extend knowledge as to the pharmacological treatment of primary glaucoma. A review of the essentials of the theory of chemical mediation of nerve impulses is made before going into the objectives of the contribution. It must constantly be borne in mind that nerve terminals, effector cells, and the neuro-effector junction are dealt with as a unit.

The mode of action of Pa-Sy-Mi and of Sy-Mi is discussed, the reactions of various drugs being noted. Indications for the use of philocarpine and eserine —drugs indiscriminately used at present without definite indication—are presented. Clinical investigations, at least for the present, place the various types of glaucoma in three groups: sympathetic, parasympathetic, and mixed. There is need for more knowl-

edge as to dysfunction or degeneration of the parasympathetic and sympathetic nerve terminals, with need of drugs or other means to reëstablish normal function. The problem is both clinical and pharmacological, it being the task of future clinicians to determine whether the types are predominantly symphathetic, parasympathetic, or mixed, and to establish which link or links of the neuro-effector units are involved in the various stages and types of the disease. (Charts.) D. F. Harbridge.

9

CRYSTALLINE LENS

Heath, Parker. **Anterior chamber irrigator.** Sec. on Ophth., Amer. Med. Assoc., 1937, 88th session, p. 260.

This is a modified 10-c.c. glass syringe with locking silver irrigating tip. (One photograph.) George H. Stine.

Preu, P. W., and Guida, F. P. **Psychoses complicating recovery from extraction of cataract.** Arch. Neurol. and Psychiatry, 1937, v. 38, Oct., p. 818.

The importance of psychiatric differential diagnosis is emphasized. Of four cases, three were diagnosed as psychogenic panic, and the fourth as senile arteriosclerosis with mental disorder. Theodore M. Shapira.

10

RETINA AND VITREOUS

Armstrong, M. V. **Angiomatosis retinae complicated by pregnancy.** Amer. Jour. Obstet. and Gynecol., 1937, v. 34, Sept., p. 494.

In a 22-year-old woman caesarian section was done, after an ophthamologist had made the diagnosis of angiomatosis retinae and had advised emptying the uterus because he believed the patient would not be able to stand further strain on the vascular system. A normal baby resulted.

Theodore M. Shapira.

Benedict, W. L. **The pathology of angioid streaks in the fundus oculi.** Trans. Sec. on Ophth., Amer. Med. Assoc., 1937, 88th session, p. 17. (See Amer. Jour. Ophth., 1938, v. 21, Jan., p. 89.)

Gilbert, W. **Detachment of the retina and indirect injury.** Klin. M. f. Augenh., 1938, v. 100, June, p. 922.

Beside reporting his own cases, Gilbert has collected from the literature the views of different authors on the question whether concussions of the head or of the whole body, or bodily overexertion, may lead to detachment of the retina. He closes the array of affirmative answers with Meller's words that without a doubt a severe bodily exertion may occasionally produce detachment of the retina. According to our present knowledge, the disproportion between physical strength and required labor must, in a whole series of pertinent cases, be one of the factors which favor detachment. The acknowledged importance of a tear may render conceivable a longer interval between trauma and detachment, as experienced in cases of detachment after cataract operations. The author thus summarizes his views: If in a given case bodily overexertion is admitted as an accident, a detachment of the retina soon following must as a rule be attributed to such accident, no matter whether it occurred in an emmetropic, a myopic, or a senile eye; and compensation should be awarded accordingly.

C. Zimmermann.

Hansen, Sören. **On the inheritance of retinitis pigmentosa.** Acta Ophth., 1938, v. 16, pts. 2-3, p. 356.

A discussion of retinitis pigmentosa from a genetic viewpoint. Because the hereditary factor appears dominant in some families and recessive in others, and because the disease is frequently associated with deafness and psychic disturbances, the author believes that occurrence of the disease depends on some contributory biologic factor in addition to the fundamental factor carrying it. Ray K. Daily.

Hanum, S., and Bröchner-Mortensen, K. **Kidney function in diabetic retinitis.** Acta Ophth., 1938, v. 16, pts. 2-3, p. 396.

The case reports and tabulated laboratory findings of twenty patients with diabetic retinitis showed a definite impairment of kidney function in only one patient with nephrosclerosis. In nineteen cases the tests for creatinin, urea, and uric acid, showed no definite deviation from normal.

Ray K. Daily.

Jakobsen, Jacob. **An isolated case of juvenile amaurotic family idiocy of the Spielmeyer-Stock type.** Acta Ophth., 1938, v. 16, pts. 2-3, p. 366.

A report of a case in a girl thirteen years of age. The disease set in with epileptiform crises beginning at the age of second dentition and increasing in severity and number. These were rapidly followed by mental deterioration; and 2½ years later appeared ocular symptoms characteristic of amaurotic family idiocy. The family history was entirely negative. Ray K. Daily.

Lijo Pavia, J. **Retinal tears. Location in the vitreous by retinal "operculums."** Trabalhos do Primeiro Congresso Brasileiro de Ophth., 1936, v. 1, pp. 167-170.

The author discusses briefly the etiology of retinal detachment and the production of the detachment by vitreous bands which pull the retina inward. The location of portions of retina ("operculums"), which either remain attached to the retina or float in the vitreous, is emphasized by the author. He believes they are of great diagnostic value in localizing retinal tears. Several observations are cited, and in the text reference is made to illustrations which are not published with the article.

Ramon Castroviejo.

Lijo Pavia, J. **Vascular affections of the retina in general disease.** Rev. Oto-Neuro-Oft., 1938, v. 13, Feb., p. 39, and March, p. 63.

This is the first of a series of articles dealing with the ophthalmoscopic changes found in association with systemic disorders. It is profusely illustrated with fundus photographs. The lesions occurring in arteriosclerosis and general arterial hypertension are discussed in some detail. The author points out that arteriosclerosis is not the cause but the effect of arterial hypertension when the two conditions coexist. In his discussion of hypertension he favors the classification of Fahr, who differentiates between hypertension of renal and that of extrarenal etiology.

The changes in the vessels and retina occurring in venous thrombosis, embolism of the central retinal artery, diabetes, various types of polycythemia, the anemias, chlorosis, leukemia, endarteritis, cardiac disease, and exsanguination are briefly described. Study of induced pulsation of the central retinal artery after the manner of Bailliart by slow-motion photography is also described, and the future possibilities of motion-picture photography in color of the retina are mentioned.

Edward B. Burch.

Lund, Steffen. **A case of amotio retinae attending scleritis.** Acta Ophth., 1938, v. 16, pts. 2-3, p. 414.

The author adds a case to the five he collected from the literature. A woman thirty years of age, had a nodular scleritis, and during a severe acute exacerbation she developed a large retinal detachment. The detached retina gradually became adherent, the detachment persisting longest adjacent to the scleritic nodule. Ray K. Daily.

Nižetić, Z., Spirdonović, R., and Bukurov, S. **Periarterial sympathectomy at the common and internal carotids with removal of the glomus caroticum. Its influence on degenerative processes in the retina and on atrophy of the optic nerve.** Klin. M. f. Augenh., 1938, v. 100, June, p. 317.

The glomus caroticum is a small organ within the connective tissue and the well developed local nervous plexus behind the bifurcation of the external and internal carotids, which here form a sinus. The glomus is not a paraganglion or endocrine gland, but is a special sensory organ which probably is destined to indicate or register certain qualitative changes of the blood. The authors observed forty cases in which they performed 63 sympathectomies, namely, 32 of atrophy of the optic nerve, 5 of retinitis pigmentosa, 2 of chorioretinitis from hereditary lues, and 1 of neuritis retrobulbaris. Twenty cases were without result. In twenty cases a certain effect of sympathectomy was observed and these are reported after description of the operative technique, with the following conclusions: Sympathectomy undoubtedly influences the retinal and general circulations and cardiac frequency. This effect is not essentially changed by decortication of the internal and common carotids or simultaneous removal of the glomus caroticum, but is increased by bilateral operation. It is, however, transitory, abating after some time. Decrease of intraocular pressure by medication or operation must be added. Sympathectomy with palliative therapy is indicated in those cases in which the process is not far advanced, the prospects for success being best in such cases.

C. Zimmermann.

Pines, N. **Some clinical notes on the nature of the retinal venous pulse.** Brit. Jour. Ophth., 1938, Aug., v. 22, pp. 470-482.

The author's lengthy discussion points out that the basic structure of the vessels is the same in the eye as in other parts of the body, with a certain modification to sustain a constant yet somewhat independent venous pressure. The retinal pulse is observed only on the disc, and is of two types: (1) the ordinary basic pulse; (2) the spontaneous pulse of piston-like movement. No displacement of the venous trunk is caused by either type. In the sclerotic eye there was found no hindrance of the basic venous pulses by an arterial crossing, while the spontaneous venous pulse became more brisk under similar conditions. No spontaneous venous pulse was noted in eyes with glaucomatous excavations. One or more veins in the same eye may show the spontaneous pulse and the rest the ordinary or basic one. It is found that each eye in the same patient forms its own combination. Digital pressure by means of Bailliart's dynamometer can vary the pulsations, the ordinary being converted into the spontaneous, with the spontaneous increasing its action but never reverting to the basic type. Of the basic type, a few or all will collapse entirely without changing to the spon-

taneous type, while the spontaneous type will also collapse but not change to the basic.

The author states that for the purposes of this article it is more important to note the percentage of eyes with a spontaneous venous pulse and then to distinguish those in which only a few or all the veins act thus. This, coupled with the author's difference in technique, accounts for his variance with the findings of Elliot and Bailliart, among others. The findings of both Elliot and Bailliart are presented in this article. A presentation of statistics further enlarges upon the findings.

It is concluded that the spontaneous retinal venous pulse is observed only on the disc and is the intensification of the basic venous pulse, as it depends on the angle of the bend of the vein when entering the disc. No clinical significance is indicated, which is deplored as perhaps the greater percentage of retinal hemmorhages are due to diseases of the veins. The venous retinal pulse fluctuates around the intraocular tension. (Description, statistics, references.) D. F. Harbridge.

Prado, Durval do L. **Thrombosis of the central vein of the retina following dental infection.** Arch. de Oft. de Buenos Aires, 1938, v. 13, Jan., p. 13.

A case of thrombosis of the central retinal vein with typical ophthalmoscopic findings is reported. The patient, 38 years of age, showed none of the usual etiological factors. An infected tooth was the only positive finding from careful clinical, laboratory, and X-ray studies. (Photograph.)

Edward B. Burch.

Raski, K. **Refraction of patients with retinitis pigmentosa.** Acta Ophth., 1938, v. 16, pts. 2-3, p. 295.

On the basis of one hundred cases of retinitis pigmentosa collected from the material of the various institutions, the author concludes that a large number of such patients are myopic, and that there probably exists a relation between myopia and retinitis pigmentosa.

Ray K. Daily.

Serr, H. **The present condition of measurement of the blood pressure in the intraocular arteries.** Graefe's Arch., 1938, v. 138, pt. 6, pp. 893-908.

The author tabulates the diastolic and systolic blood pressure in the central retinal arteries as reported by 26 different observers, using the dynamometer method of Bailliart. (It is immaterial which dynamometer is employed.) It is most important that taking of the measurement be rapid, so as to avoid, as far as possible, an error from the "choking" necessarily produced by the dynamometer pressure. In this way, the normal height in man should not exceed 30 to 40 mm. Hg for the diastolic and 60 to 70 mm. Hg for the systolic blood pressure in the central retinal artery. H. D. Lamb.

Wagner, H. **A hitherto unknown hereditary affection of the eye (degeneratio hyaloideo-retinalis hereditaria), observed in the Canton of Zurich.** Klin. M. f. Augenh., 1938, v. 100, June, p. 840; also Schweiz. med. Woch., 1938, July 2, p. 761.

From 1934 on the author observed this new affection of retina and vitreous in a family whose genealogic tree he could follow through three generations. Thirteen out of 26 members examined presented the changes typical for this affection, which appears to start from the retina and vitreous and is probably congenital. Its characteristic symptoms follow: Optically the vitreous is almost

clear, being traversed by fine filaments. The anterior limiting stratum and the normal structure of the vitreous are absent and the vitreous is very much liquefied. At the periphery of the retina are transparent perforated circular membranes adherent to the limitans interna and projecting into the vitreous. The retinal vessels, especially the arteries, appear attenuated, and some present white sheaths. In the periphery pigment foci are visible. Often atrophy and vascular sclerosis are found in the choroid. Some cases showed pale yellowish discs and one showed complete white atrophy of the optic nerve. All affected individuals were myopic about 3 to 4 D., and some had direct corneal astigmatism. Concentric contraction of the visual field and impaired vision were typical. Except the youngest, all had peculiar posterior cortical opacities of the lens and later nuclear cataract. In consequence of atrophy of the optic nerve in middle age complete blindness may ensue. This hyaloideo-retinal degeneration shows a dominant hereditary succession. Its spread ought to be prevented. C. Zimmermann.

Weve, H. **Ablatio falciformis congenita (retinal fold).** Brit. Jour. Ophth., 1938, v. 22, Aug., pp. 456-470.

The author has found through his own investigations, as well as those of Mann, Holm, and Manen, that the disease discussed is bilateral in 50 percent of the cases studied and reported. The fact that the fold is symmetrical in all bilateral cases observed points to abnormal development and against inflammation. Of the personal studies reported by the author, the occurrence was familial in four out of five of the cases outlined in this article. Discussion is presented to substantiate the opinion of abnormal development as against inflammation. It is the opinion of the author that even though evidence indicates strongly that so-called ablatio falciformis congenita is a developmental abnormality, knowledge is still incomplete and detailed study of every case that comes for examination and treatment is necessary before positive statements can be made. (Fully described figures; references.) D. F. Harbridge.

11

OPTIC NERVE AND TOXIC AMBLYOPIAS

Baker, A. B., and Platon, E. S. **Cerebral changes in amaurotic family idiocy.** Arch. of Path., 1938, v. 25, Jan., pp. 75-82.

A case of Tay-Sachs disease in which there was extensive involvement of the central nervous system is reported. The most striking changes were found within the tissues of neuro-ectodermal origin, and consisted of primary swelling of the cells followed by deposition of granules, many areas showing absence of myelin. The authors conclude that the disease is an endogenous condition involving the ectodermal elements. T. E. Sanders.

Brown, R. B., and Schwarz, G. A. **Optic neuritis in hyperthyroidism.** Arch. Internal Med., 1937, v. 60, Oct., p. 668.

A woman of thirty years is presented who had a thyrotoxicosis with optic neuritis. Despite the presence of other possible etiologic factors, it is believed that hyperthyroidism was the cause of the optic neuritis, because of the parallel fluctuations of the inflammation of the optic nerve and of the thyrotoxic state. Theodore M. Shapira.

Dolgopol, V. B. **Neuromyelitis optica with pathologic study of a case.** Arch.

Neurol. and Psychiatry, 1938, v. 39, March, pp. 561-569.

The patient died of pneumonia three years after onset of symptoms. Pathologically the central nervous system showed loss of myelin with some perivascular infiltration but no destruction of the axis cylinder. The optic nerves showed perivascular infiltrations around tortuous blood vessels but no marked demyelinization or loss of axis cylinder.

T. E. Sanders.

McConnell, A. A., and Mooney, A. J. **On normal discs in patients with chiasmal lesions.** Brain, 1938, v. 61, pt. 1, March, p. 37.

In the majority of cases of pituitary tumor the optic discs are pale, but in a certain number of cases the discs are normal in appearance or "within normal limits." There is a widespread notion that in patients with the gross field defects that are found in such cases the discs must have been atrophic in appearance, and some surgeons have been inclined to question the accuracy of the ophthalmologist's observation. This paper is based on six cases of tumor involving the chiasm in which the discs were normal. In five cases the tumor was behind the chiasm. In the sixth case the tumor was of an unusual prechiasmal type. Not one of the patients whose histories are given came to the hospital because of failing vision, but all came because of pain in the head. Retrochiasmal tumors (which greatly preponderate) are more often associated with severe headache than are prechiasmal tumors. The difference in operative mortality between the two groups is very marked. In the author's first group, with normal discs, four out of six patients died. In a group of prechiasmal tumors with primary optic atrophy, only one out of eight patients died. The authors conclude that when the optic discs of a patient with chiasmal symptoms are pronounced normal by an experienced ophthalmologist, it is probable that the cause, if a tumor, will be found behind the chiasm.

Ralph W. Danielson.

Mayer, L. L. **Tryparsamide therapy of neurosyphilis and atrophy of the optic nerve.** Trans. Sec. on Ophth., Amer. Med. Assoc., 1937, 88th session, p. 53. (See Amer. Jour. Ophth., 1938, v. 21, Aug., p. 955.)

Nižetić, Z., Spirdonović, R., and Bukurov, S. **Periarterial sympathectomy at the common and internal carotid with removal of the glomus caroticum. Its influence on degenerative processes in the retina and on atrophy of the optic nerve.** Klin. M. f. Augenh., 1938, v. 100, June, p. 317. (See Section 10, Retina and vitreous).

Papez, J. W., and Rundles, W. R. **A case of epilepsy with meningioma of the optic nerve.** Arch. Neurol. and Psychiatry, 1938, v. 39, Jan., p. 150.

In a case of long-standing blindness in the right eye, the outstanding observation was a meningioma of the optic nerve situated at the optic foramen. Death occurred at the age of 76 years. Twenty years prior to death there occurred an attack of retrobulbar optic neuritis which resulted in blindness. Olfactory aura appeared and epilepsy began fifteen years prior to death. Dural calcification, thalamic lesions, and a meningioma of the right optic nerve were found at autopsy. F. M. Crage.

Pickard, Ranson. **The photochromatic interval in glaucoma and cavernous atrophy.** Brit. Jour. Ophth., 1938, v. 22, July, pp. 391-400. (See Section 8, Glaucoma and ocular tension.)

12

VISUAL TRACTS AND CENTERS

Elsberg, C. A., and Spotnitz, H. **Neural correlations of vision and their significance for localization of tumors of the brain.** Arch. Neurol. and Psychiatry, 1938, v. 39, Feb., pp. 315-326.

The average duration of the refractory period of adaptation for each eye to both a continuous and a flickering light was measured in fifty cases of suspected intracranial disease. In cases of supratentorial tumor the duration after continuous light is longer in the contralateral eye. When the lesion is in the frontal lobe, the duration in the homolateral eye is longer after flickering than continuous light. When the lesion is in the parietal or occipital lobe the duration in the homolateral eye is shorter with the flickering light. (See also Amer. Jour. Ophth., 1938, v. 21, p. 1064.) T. E. Sanders.

Jefferson, Geoffrey. **Compression of the chiasm, optic nerves, and optic tracts by intracranial aneurysms.** Brain, 1937, v. 60, Dec., pp. 444-487.

Twelve cases of intracranial aneurysm affecting the visual pathways are reported out of a total of 53 such cases. These are divided into four groups: those interfering with the optic radiation and striate cortex, 3 cases; optic tract, 1 case; optic nerves, 2 cases; chiasm, 6 cases. The most characteristic fields with aneurysm show scotoma in the homolateral eye with an overlying homonymous defect in the nasal field of that eye and in the temporal field of the other. T. E. Sanders.

Siegert, Peter. **The etiologic significance of calcification or thrombosis of the internal carotid in functional disturbances of the eye.** Graefe's Arch., 1938, v. 138, pt. 6, pp. 798-844.

In almost 50 percent of 33 patients over sixty years of age, chosen without regard to the ocular findings, roentgen-ray examination showed calcification of the internal carotid artery. When such sclerosis was demonstrated, ophthalmoscopic observation always revealed arteriosclerotic changes of the retinal blood vessels. Calcification of the internal carotid was found very rarely to cause functional disturbances in the eye by compression on the optic nerve. Ocular disturbances were overwhelmingly produced by nutritional changes caused by arteriosclerosis or encephalomalacia. This conclusion is particularly true as to simple descending optic atrophy. H. D. Lamb.

Tertsch, R. **Binocular changes in fracture of the skull.** Klin. M. f. Augenh., 1938, v. 100, June, p. 857.

In a team runaway a boy of sixteen years fell from the wagon on his face and sustained a fracture of the mandible and the base of the skull, and extensive fractures of the cranium. According to the roentgen examination the optic-nerve canals were intact. The motility of both eyes was almost abolished for several days, and the pupils were wide and immovable, with no perception of light and extensive retinal hemorrhages. Such bilateral ocular changes after traumas of the skull are rare, probably because the majority of the injured die before an ophthalmoscopic examination can be made. Hence the relatively favorable termination of this severe cranial injury is remarkable. Apart from the ocular changes it left no defects. V.R. 20/50. V.L. hand movements. The retinal hemorrhages were caused by occlusion of the veins; and they, the descending atrophy of the optic nerves, and the pupillary disturbances are all attributed to hematoma of

the optic sheaths. The blood apparently came from the anterior cranial fossa. Both ocular fundi presented vesicular detachment of the limiting membrane of the vitreous by the retinal hemorrhages, and degenerative changes such as are observed in connection with traumas of the skull.

C. Zimmermann.

13

EYEBALL AND ORBIT

Herschendörfer, A. **Additional remarks on plastic surgery of the orbit.** Klinika Oczna, 1938, v. 16, pt. 3, p. 329.

Herschendörfer claims priority as to introduction of a free cutaneous flap in orbital plastic surgery. He objects to an article on the subject by Lauterstein, who credits Meller with the procedure.

Ray K. Daily.

Paiva, Aroldo. **Congenital unilateral familial melanosis.** Arch. de Oft. de Buenos Aires, 1938, v. 13, Jan., p. 8.

Unilateral melanosis of the globe and adnexa involved the skin of the cheek and lids, the bulbar conjunctiva, the iris, and the fundus. The literature pertaining to this condition is reviewed and the differential diagnosis is discussed. Edward B. Burch.

Pereira, R. F. **Opticociliary neurectomy.** Arch. de Oft. de Buenos Aires, 1938, v. 13, Feb., p. 1. (See Section 8, Glaucoma and ocular tension.)

14

EYELIDS AND LACRIMAL APPARATUS

Adda, Viktor. **Strand fixation of the right upper lid. Pseudo-Graefe phenomenon.** Klin. M. f. Augenh., 1938, v. 101, July, p. 65.

A boy of five years presented a pseudo-Graefe phenomenon of the right upper lid. The right palpebral fissure was slightly narrower than the left, and the upper lid was flattened, and covered the upper third of the cornea on looking straight forward. On looking down, a part of the sclera 5 mm. wide remained uncovered, and the flattening in the center of the lid was converted into a shallow groove with slight retraction of the border of the lid. Closure of the lid was only possible by the orbicularis and during sleep the palpebral fissure gaped about 3 mm. The affection was attributed to a cicatricial retraction in the upper lid. Through an incision above the convex margin of the tarsus, with separation of the scanty fibers of the palpebral muscle, a sinewy cicatricial tissue adherent to the surface of the conjunctiva was exposed. No trace of a levator could be discovered. By cutting the cicatricial tissue, pulling the lid down by a suture, and fixating it to the cheek with adhesive plaster, the condition improved after four days, the flattening of the lid and the retraction of the lid margin having subsided and only a small zone of the cornea remaining uncovered during sleep. By change in the levator, the action of the superior rectus was transferred to the lid and caused its elevation. The case is related to those of congenital ptosis in which the levator alone is paretic. (Illustrated.) C. Zimmermann.

Hourn, G. E. **X-ray visualization of nasolacrimal duct.** Ann. Otol., Rhinol., and Laryngol., 1937, v. 46, Dec., pp. 962-975.

A method of X-ray visualization of the nasolacrimal duct is described, using an intranasal dental film and lipiodol injection of the sac.

T. E. Sanders.

Larsson, Sven. **Treatment of congenital atresia of the nasolacrimal duct.** Acta Ophth., 1938, v. 16, pts. 2-3, p. 271.

The author attributes the failure of probing to open the nasal end of the lacrimal duct, in infants with congenital atresia of the nasal opening, to anatomical variations in the position of the duct. For such cases he recommends removal of the anterior portion of the inferior turbinate, and incision of the nasal mucous membrane over a probe introduced through the lacrimal sac. Two case histories illustrate the effectiveness of this procedure. (Illustrations.)

Ray K. Daily.

Michail, D. **Researches on symmetric lymphoma of the lacrimal glands.** Bull. de l'Acad. de Méd. de Roumanie, 1938, v. 5, no. 2, pp. 137-153.

With a review of the literature, two personal cases are reported. In a woman of thirty years, after typhoid fever, inflammatory tumors developed in the lacrimal glands, first the left and then the right. Tuberculosis and syphilis could both be excluded, and the author concludes that the typhoid fever was responsible for development of the lymphomata. The patient remained healthy after removal of the masses. In the second patient, a man of 21 years, the symptoms included symmetric lacrimal swellings accompanied by exophthalmos. Two months after bilateral extirpation of the lacrimal tumors there was recurrence on one side with an infiltrative scleral corneal and conjunctival lesion, nodular parotid and palatine lesions on the left side, induration of the submaxillary ganglia, and cutaneous nodules on the face, the trunk, and the limbs, accompanied by joint pains and general weakness. The general diagnosis in this case was of aleukemic lymphadenosis.

W. H. Crisp.

Michelson, H. E., and Laymon, C. W. **Lichen planus of the eyelids.** Arch. Dermat. and Syphil., 1938, v. 37, Jan., p. 27.

Though the eyelids seem immune to this disease, the authors saw five cases manifesting unmistakable lesions. All were in brunet women. Three types of lesions were encountered. The rarity of the condition is emphasized.

F. M. Crage.

Renard, G., and Halbron, P. **The palpebral manifestations of tertiary syphilis.** Arch. d'Opht. etc., 1938, v. 2, July, p. 599.

Chancre of the lids is seen much more often than are tertiary lesions (gumma or ulceration). These latter are seen especially in acquired syphilis. The patients are adults between thirty and fifty years old. Women are more often affected than men. The lesions appear from three years even to twenty years after the initial infection. Tertiary may, however, be contemporary with secondary lesions. Adenopathy is rare. Gumma, tarsitis, and very rarely syphilitic edema are the forms observed. These are carefully described. A case of ulcerations of the right eyelids in a woman of 39 years is reported. They appeared one year after the secondary stage. Antisyphilitic treatment rapidly cured. (Bibliography, photographs.)

Derrick Vail.

Scharf, Josef. **Familial ptosis and supranuclear ophthalmoplegia.** Klin. M. f. Augenh., 1938, v. 101, July, p. 71.

Three of five children of the same family, aged 25, 27, and 39 years, showed congenital ptosis and incomplete paralysis of fixation. The ptosis operation according to Hess and Elschnig gave very satisfactory results in all three. (Illustrated.)

C. Zimmermann.

Shimkin, N. I. **Transplantation of the ear concha as a new method of correcting spastic entropion of the upper lid following total tarsectomy.** Rev. Internat. du Trachome, 1938, v. 15, Jan., p. 15. (See Amer. Jour. Ophth., 1938, v. 21, Aug., p. 959.)

Solanes, M. P. **A case of chancre of the eyelid, etc., etc.** Anales Soc. Mexicana de Oft. y Oto-Rino-Laring., 1937, v. 12, Oct.-Nov.-Dec., pp. 97-100.

The patient was a boy of fourteen months. Of the four children of the marriage two others had at the same time secondary manifestations of syphilis, recently acquired, apparently from the mother, who had been infected five months before the date of examination of the children. W. H. Crisp.

Spaeth, E. B. **Ptosis and its surgical correction.** Trans. Sec. on Ophth., Amer. Med. Assoc., 1937, 88th session, p. 66. (See Amer. Jour. Ophth., 1938, v. 21, Aug., p. 959.)

Stallard, H. B. **A modified Briggs retractor for dacryocystorhinostomy.** Brit. Jour. Ophth., 1938, v. 22, June, p. 361.

The instrument is described and defended as being neater and more exact than other hand retractors. (Illustrated.) D. F. Harbridge.

Stokes, W. H. **Dacryocystitis in lymphatic leukemia.** Arch. of Ophth., 1938, v. 20, July, pp. 85-87.

A woman aged 68 years developed bilateral fistula of the tear sac following incision for acute dacryocystitis. There was a symmetrical enlargement of the lacrimal glands, and slight enlargement of the glands of the neck, axilla, and groin. After extirpation of the sac it was found that the wall was infiltrated with lymphocytes and lymphoblasts, giving the appearance of a lymphocytoma or a leukemic infiltration. (Photomicrographs.)

J. Hewitt Judd.

Valle, Donato. **Different methods of treatment of dacryocystitis.** Trabalhos do Primeiro Cong. Brasileiro de Ophth., 1936, v. 1, pp. 228-234.

The author advocates the use of dacryocystorhinostomy, which he has performed 26 times, following the Dupuy-Dutemps, Toti, Toti-Arruga, Polyak-West, Poulard, Meller-Rollet, and Browmann techniques. Only three cases resulted in failure.

Ramon Castroviejo.

15

TUMORS

Angius, Tullio. **Primary histiocytoma of the lacrimal gland.** Rassegna Ital. d'Ottal, 1938, v. 7, March-April, p. 191.

The patient described by Angius was a 39-year-old woman presenting the usual clinical signs of a tumor of the lacrimal gland. He bases the diagnosis of histiocytoma on the following factors: limited extension, relative uniformity of distribution of the parenchyma throughout the stroma, the richness of well preserved vessels in all parts of the specimen, the form of the cells, and their intimate relation to the reticulum as shown by Mallory's stain. (Extensive bibliography, discussion, 8 figures.) Eugene M. Blake.

Argaud, R., and Calmettes, L. **Considerations on a retino-glioma in a 16-month-old infant.** Arch. d'Opht. etc., 1938, v. 2, July, p. 593.

The left eye of a sixteen-month-old female was buphthalmic, glaucomatous, and cataractous. The parents gave a

vague history of a pecular pupillary reflex noticed when the infant was eight months old. A diagnosis of glioma retinae was made and the eye enucleated. The tumor occupied two thirds of the vitreous chamber. All of the intraocular vessels were widely dilated. Typical rosettes were observed, but in addition the tumor was rich in glial tissue. The authors believe that retinal gliomas are embryonic neoplasms formed from arrested elements, indifferent cells, and even spongioblasts remaining in a latent state. The term glioma should not be rejected because neuroglia plays a great part in the tumor's constitution, and its appearance and consistency are absolutely those of glia. (5 photomicrographs.)

Derrick Vail.

Cerckez, V. **Fibroma of the sclera.** Ann. d'Ocul., 1938, v. 175, May, pp. 390-396.

Fibroma of the sclera is a rare tumor which grows slowly, is usually benign, and does not affect vision until an advanced stage with exophthalmos or nerve invasion is reached. A good prognosis accompanies complete removal. Report of one case.

John M. McLean.

Cookson, H. A., and MacRae, A. **Lymphoid tumor of the lacrimal gland.** Brit. Jour. Ophth., 1938, v. 22, July, pp. 385-391.

A case of leukemic infiltration from a tumor of the lacrimal gland is reported, the patient being a girl aged nine years. Six months before the swelling of the right upper lid was first noticed the eye had been struck against a radio instrument. The patient was placed on the hospital waiting list for removal of the enlarged lacrimal gland. But a fall and subsequent death from illness, during which palpable glands were noted in both groins, prevented operation. Postmortem findings indicated leukemic infiltration. (Figures.)

D. F. Harbridge.

Denti, Andrea. **Retinoblastoma with metastasis to the iris, and hypopyon.** Rassegna Ital. d'Ottal., 1938, v. 7, March-April, p. 243.

The author describes a case of retinoblastoma which showed numerous small whitish points in the iris, near the larger circle. There was a pseudohypopyon at the bottom of the anterior chamber, and no fundus reflex. The tension was 40 mm. (Schiötz). Exploratory puncture of the anterior chamber demonstrated the presence of numerous small round cells of sarcomatous aspect, with large nuclei and little protoplasm. Denti stresses the value of the puncture in such cases. (4 figures.)

Eugene M. Blake.

Schmidt, Jenö. **Fibroma of the sclera.** Graefe's Arch., 1938, v. 138, pt. 6, pp. 748-759.

Retinal detachment occurred below in the left eye of a 49-year-old man. The detachment was noted to be prominently bulging and sharply circumscribed. The choroid could be seen through the retina. After puncture with a syringe in the vicinity of the detachment, transillumination presented a dark shadow. On bisecting the enucleated eyeball, a tumor 1.5 cm. long and 1 cm. high lay antero-inferiorly, with its round base arising from the internal surface of the sclera. It pushed the choroid and retina ahead of it. In consistency and color, the growth resembled the sclera, being very firm and hard. It was composed of collagenous connective tissue, containing few cells and blood vessels. This is the first re-

ported case of a neoplasm from the sclera extending into the interior of the eye. H. D. Lamb.

Siotto, Giovanni. **Melanoma of the lacrimal caruncle.** Rassegna Ital. d'Ottal., 1938, v. 7, March-April, p. 178.

The author considers the various tumors of the caruncle and reviews the published cases of melanoma. He adds a new case, occurring in a man of 31 years, a subject of trachoma. The pigmented spot had been first noticed at the age of six years and had remained unchanged in size for twenty years, until it was injured by a companion. Following the trauma growth was slow but steady. Histologically the mass was a melanoma. Early and complete removal of such masses is urged. (6 figures.) Eugene M. Blake.

16
INJURIES

Clemmesen, Viggo. **Eye injuries from war gases.** Hospitalstidende, 1938. v. 81, March 15, pp. 264-271.

In the event of any modern war, it must be assumed that attacks on the civil population are very likely and that in these attacks poison gas will be used. All known war gases are capable of causing injuries to the eyes. General prevention of gas injuries would be aimed at by distribution of gas masks, construction of available bombproof and gasproof rooms, and general training in first aid treatment.

War gases are divided for practical purposes, according to their actions, into four groups: (1) Tear gases, the commonest being chloracetophenon. The eyes should be washed with a 2-percent sodium-bicarbonate solution or 0.4-percent sulphite in water and glycerine 1 to 4. (2) Sneezing gases. These are compounds of arsenic, of which lewisite is one. Eye injuries from these are mostly superficial and immediate treatment is the irrigation of the eye with mild alkaline solutions. (3) Gases affecting the lungs—phosgen, diphosgen, and nitrochloroform (the green gases). These are very irritating, especially to the lungs and to all mucous surfaces as well as to the eyes. Boric-acid solution, as well as mild alkaline solutions and alkaline ointments, are useful. (4) Gases irritating the skin. The most used in this group is commonly known as mustard gas (yellow gas). Mustard gas produces the severest eye lesions of all: irritation of the conjunctiva, opacities and ulcerations of the cornea, often with perforation and blindness. The best protection is offered by the gas mask. Dry chloride of lime (calcium hypochlorite) rubbed into the skin of the eyelids is a protectant. Alkaline solutions and ointments, containing calcium carbonate and lime water, are useful. D. L. Tilderquist.

Glover, L. P. **Chemical conjunctivitis of the new-born.** Pennsylvania Med. Jour., 1937, v. 40, Sept., p. 1035.

The author states that chemical conjunctivitis of the new-born is due to old silver preparations. This type may be mistaken for the gonorrheal type. All silver preparations should be made up freshly each week in new bottles. Chemical conjunctivitis may cause complete or partial loss of sight. It may also cause chronic dacryocystitis.

Theodore M. Shapira.

Goar, E. L. **Angioid streaks in the ocular fundus with traumatic rupture of the choroid.** Amer. Jour. Ophth., 1938, v. 21, Aug., pp. 907-910.

Nechitch, G. **A powerful electromagnet, automatically controlled, on a mov-**

able carriage, designed for ophthalmology and general surgery. Ann. d'Ocul., 1938, v. 175, July, pp. 507-543.

Mechanical details of the instrument are described at length. In spite of its great size and weight the magnet is easily operated.

Extractions, except on children, are done under local anesthesia with 1-percent pontocaine. The patient should always be in a horizontal position. Usually the giant magnet is used to bring the foreign body into the anterior or posterior chamber, whence it can be removed with a small magnet. The posterior route is avoided, if possible, because damage to retina and choroid or loss of vitreous are more to be feared than injury to the lens in the anterior approach. John M. McLean.

Nižetić, Zdravko. **Surgical treatment of traumatic iridodialysis.** Klin. M. f. Augenh., 1938, v. 100, June, p. 900.

Three cases were operated upon by incarcerating the root of the detached iris in the limbus through a small incision made with the lance-shaped knife, with good results. The author considers the operative to be the only correct treatment. C. Zimmermann.

Oláh, Emil. **Punctured wounds of the ciliary body.** Klin. M. f. Augenh., 1938, v. 100, June, p. 905.

By two cases Oláh shows that punctured wounds with incarceration of the ciliary body, followed by its liberation and abscission, are not dangerous if no infection occurs. The operation is the more successful if performed early. Incarceration if not freed leads to cyclitis and destruction of the eye.

C. Zimmermann.

Raverdino, Emilio. **Use of a metal ring on the limbus for localizing foreign bodies.** Rassegna Ital. d'Ottal., 1938, v. 7, March-April, p. 222.

Raverdino has a series of rings of fine silver wire, varying from 8 to 14 mm. in diameter. He chooses one which just includes the edge of clear cornea in a given case, and sutures it in place with four silk sutures. With the patient flat on his back, the space from the ring to the apex of the cornea is measured. This allows one to obtain a measurement for the anterior surface of the cornea. The exact details of the radiographic technique are given and six cases are reported in which the method was followed. Use of the silver-wire ring at the limbus affords an accurate way of determining the size and position of intraocular and intraorbital foreign bodies. (17 illustrations.)

Eugene M. Blake.

Thiel, R. **The operative treatment of traumatic iridodialysis.** Klin. M. f. Augenh., 1938, v. 100, June, p. 918.

The good result with normal vision in the reported case showed that the attempt must be made to draw the detached root of the iris into the sinus and to incarcerate it in the corneal wound.

C. Zimmermann.

17

SYSTEMIC DISEASES AND PARASITES

Aylesworth, F. A. **An unusual affection of the eye in leukemia.** Canadian Med. Assoc. Jour., 1938, v. 38, May, p. 477.

The author gives in detail the case report of a 56-year-old woman with leukemia. A conspicuous feature of the case was marked swelling of the lids and conjunctiva. Microscopic examination of the eye removed at autopsy revealed essentially a small round-cell infiltration of most of the structures of

the eyeball. Attention is called to other cases of leukemia in which edema of the eye was a feature. (4 references.)
Ralph W. Danielson.

Burrows, M. T. **A case of trigeminal neuralgia with osteitis of the wall of the infraorbital canal.** Amer. Jour. Surg., 1937, v. 37, Sept., p. 506.

A case of tic douloureux in a 47-year-old woman. Pain began in the right cheek and radiated to the lower part of the right forehead. By X ray, an indefinite suggestion of a foreign body was seen; and an exploratory operation was done. By accident, says Burrows, dead bone was found behind the right antrum in the direction of the orbital canal. After removal of this bone the pain disappeared. Theodore M. Shapira.

Cicero, R. E. **Syphilitic chancre of the eyes.** Anales Soc. Mexicana de Oft. y Oto-Rino-Laring., 1937, v. 12, Oct.-Nov.-Dec., pp. 89-96.

A general survey of the subject.

Custodis, E. **Eye symptoms in tumors of the epipharynx.** Klin. M. f. Augenh., 1938, v. 101, July, p. 49.

In connection with reports of four cases, Custodis demonstrates that benign and malignant tumors of the epipharynx may lead to disturbances of the sensory, motor, and sympathetic nerve fibers supplying the eye. While malignant newformations of the epipharynx of ophthalmologic interest are marked by a characteristic complex of symptoms, the benign tumors appear in various clinical aspects. In doubtful disorders of the nerves leading to the eye and orbit a rhinological examination of the epipharynx is necessary, otherwise the tumors may easily be overlooked on account of their frequent lack of nasal symptoms and their hidden location. The diagnosis is essentially facilitated by roentgen examination. By axial exposure of the cranial base and the antero-posterior skiagraphy of the skull such tumors show changes of diagnostic value. (Illustrated.) C. Zimmermann.

Németh, Lajos. **Some rare ocular affections in connection with disturbed menstrual cycle.** Klin. M. f. Augenh., 1938, v. 101, July, p. 83.

Cases described include eczema of all the lids, lymphatic eruptions, and vascular tonic spasms during the menses. They are explained as due to diminished endocrine secretion of the ovaries, from defective development, or from diminished function due to age. Mostly they were favorably influenced by hormone treatment with ovarian extracts. A woman of 48 years, in whom retarded menstruation indicated the approaching climacteric, presented the picture of embolism of the central retinal artery caused by vascular spasm and ending in amaurosis. C. Zimmermann.

Thurel, Robert. **Phenolization of the sphenopalatine ganglion in ophthalmology.** Arch. d'Opht. etc., 1938, v. 2, June, p. 506.

Neuralgia of the head and face, especially ocular and orbital pain, has been relieved by applying carbolic acid to the sphenopalatine ganglion. The acid eats its way through the mucous membrane behind the middle turbinate, destroys the nerve fibers, and penetrates through the sphenopalatine foramen in the pterygo-maxillary fossa to the ganglion. A cotton tampon saturated with carbolic acid is used. To obtain the desired result it is necessary to make frequent applications for an hour, and to repeat the treatment three times, at intervals of several days.

The treatment has been beneficial in alleviating the symptoms and favorably influencing the course of episcleritis, subacute and chronic glaucoma, neuroparalytic keratitis, iritis, vasomotor crises, photophobia, and retrobulbar optic neuritis. (Bibliography.)

Derrick Vail.

Viallefont and Fuentes. **Leprosy in ophthalmology.** Ann. d'Ocul., 1938, v. 175, May, pp. 380-390.

Leprosy produces, about the eye and in the lids, typical skin lesions which are often followed by entropion or ectropion. Occasionally an isolated nodule may resemble a chalazion. Facial paralysis is common and oculomotor palsies are often seen. Infections of the lacrimal sac are not uncommon in lepers and probably play a part in the conjunctival and corneal affections. Although conjunctival infections with the leprosy bacillus are not known, conjunctival reactions are seen over scleral nodules. Among ocular lesions, keratitis is one of the most common and usually resembles tuberculous parenchymatous disease, going on to complete scar formation. Small interstitial lepromas of the cornea are sometimes seen and secondary corneal involvement may follow lagophthalmos or destruction of the sensory nerves. Iritis, cylitis, and iridocyclitis are very common, probably being the chief causes of blindness in leprosy. Although the ocular picture may not be typical, the general condition facilitates diagnosis. Proved lesions in the fundus or optic nerve are rare.

Treatment consists of the usual local procedures and general measures such as chaulmoogra oil, methylene blue, and chaulmoogra-cholesterol. Ocular surgery is not particularly contraindicated in leprosy.

John M. McLean.

18

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Berens, C., and Goldberg, J. A. **Syphilis in relation to the prevention of blindness.** Trans. Sec. on Ophth., Amer. Med. Assoc., 1937, 88th session, p. 29. (See Amer. Jour. Ophth., 1938, v. 21, Jan., p. 114.)

Blatt, Nicholas. **Reflections on the Fifteenth International Ophthalmological Congress.** Ann. d'Ocul., 1938, v. 175, April, pp. 325-329.

An account of the Congress which does not lend itself well to abstracting.

Catsch, Alexander. **Observations in correlation pathology. The correlation of hereditary disease and anlage disturbances of the eye.** Graefe's Arch., 1938, v. 138, pt. 6, pp. 867-892.

Among 26,735 patients, there occurred 1,645 cases distributed over 29 hereditary ocular conditions. The numbers of males and females of this series are plotted in curves for each five years of age from 0 to 95 years. On the same chart, the curves for the normal males and females for each five years of age are plotted for the purpose of comparison. Of the males of this series, hereditary ocular changes were found to be a little more numerous in those fifteen years old, whereas of the females of the series such changes were much more common in those seventy years of age. Using 1,906 instances of the 21 more common hereditary ocular conditions of this series, eight double tables and two single ones are presented to show the frequency of simultaneous occurrence in one patient of two or more of these 21 hereditary conditions. A double table is also given showing the number of each of the 1,906 instances having myopia or hyperopia of 5 D. or more.

The paper represents an immense amount of work and reports many associations of hereditary ocular disease not previously described.

H. D. Lamb.

Cornet, Emmanuel. **Trachoma and lymphoid affections of the pharynx.** Rev. Internat. du Trachome, 1938, v. 15, April, p. 74.

Four thousand school children of Pnompenh (French Indo-China), were examined between the ages of 4 and 24 years. Trachoma was diagnosed in 44 percent. Extensive statistical tables do not indicate any relationship between pharyngeal lymphoid hyperphasia and trachoma. J. Wesley McKinney.

Dutt, K. C. **Cataract operations in the prehistoric age.** Arch. of Ophth., 1938, v. 20, July, pp. 1-15.

The first authentic record of an operation for cataract is found in a treatise on surgery, "Suśruta Sanhita," written about 1000 B.C. by Suśruta. Excerpts from the author's translation present Suśruta's classification of cataract, a description of the original operation which was the depression method of couching by the anterior route, the routine postoperative treatment, and the contraindications for couching. The modifications of the original technique made by surgeons in Arabia, Bagdad, Egypt, Alexandria, Babylon, Jerusalem, Athens, Rome, and other countries of Europe, are presented. Many of the original instructions are still valuable, and the author points out that couching still has a place in the surgical treatment of cataract. J. Hewitt Judd.

Esser, A. A. M. **Tears and amber in ancient myth.** Klin. M. f. Augenh., 1938, v. 101, July, p. 88.

Quotations from Plinius and others speak of the relations of amber with tears and the eye. C. Zimmermann.

Ferree, C. E., and Rand, G. **Testing fitness for night flying: visual acuity.** Arch. of Ophth., 1938, v. 20, July, pp. 58-79.

Important functions to be tested in determining the fitness for night flying are: the ability to see at night and at low illumination and the effect of dark adaptation upon this ability, and the amount and speed of dark adaptation. The speed is more important than the amount. A suitable instrument and test object, and a circle with a double break, are recommended and their advantages for making the test are briefly discussed. A comparison is made of the merits of visual acuity and those of light sense as a means of testing fitness for night flying. J. Hewitt Judd.

Gradle, H. S., and Francois, W. de. **The visual ravages of trachoma.** Trans. Sec. on Ophth., Amer. Med. Assoc., 1937, 88th session, p. 25. (See Amer. Jour. Ophth., 1937, v. 20, Nov., p. 1185.)

Greeff, R. **What portraits of Albrecht Graefe do we possess?** Contribution 3. Graefe's Arch., 1938, v. 138, pt. 6, pp. 737-747.

Another previously unknown picture of Graefe operating, recently received, is reproduced. The original was a woodcut appearing in the periodical "Ueber Land und Meer" for October, 1869. Around the operator are grouped as observers Sir Henry R. Swanzy of Dublin, Hasket Derby (1835-1914) of Boston, Theodore Leber, and Evers.

There is described and illustrated Graefe's operating table 75 cm. high, 74 cm. broad, and 180 cm. long. After the original owner's death, the table

was in use between 1871 and 1918. Now it is in the historical division of the Kaiserin-Friedrich House for medical progress.

Two more oil paintings and two more photographs of Graefe are shown. The last, taken in the middle of the year 1870, shortly before his death, shows him much changed from illness.

H. D. Lamb.

Kaz, R. A. **Children with defective vision, in need or not of sight-saving classes.** Brit. Jour. Ophth., 1938, v. 22, Aug., pp. 486-488.

Cases are presented. One patient was spared the sight-saving class. One required and received sight-saving treatment. Another was admitted to the sight-saving class and later sent to the school for the blind. A fourth dispensed with the sight-saving class. This article follows previous findings (see Amer. Jour. Ophth., 1937, v. 20, p. 982). (References.) D. F. Harbridge.

Kaz, R. A. **Light reserve for occupations in sight-saving classes.** Brit. Jour. Ophth., 1938, v. 22, Aug., pp. 482-485.

Physiotherapeutic treatment for young patients with defective eyesight is discussed, it being pointed out that steady improvement depends on the conduct of sight-saving classes, especially as relates to sufficiency of light for occupations. First forty years ago, and again twenty-six years ago, the author presented the idea of reserve light as conservator for the working eyes. Overfatigue in the eyes of journalists working at night; clerks working at figures without proper light; hypermetropes endeavoring to do without their glasses; myopes bending closely over their work; and children with feeble sight whose glasses deflect part of the light or who work with insufficient light, are discussed. The symptoms of this overfatigue are: photophobia; epiphora; red eyelids and sometimes chalazia; continuous winking of the lids; twitching of the eyelids; itching and the sense of burning and pressure in the eyelids; heat in the eyes or the sense of a foreign body under the lids; gluing of the lids after sleep; flying spots; rapid fatigue of retina and of muscles; irritability of the entire mechanism; and headache.

It is the opinion of the author that as much attention should be directed to the sufficiency of light in all working conditions as is paid to proper temperature and the length of the working day. Figures demonstrate the author's conception of proper lighting. (References.) D. F. Harbridge.

Keller, P. **How to realize a rational and efficacious social prophylaxis of trachoma in Indo-China and especially in Tonkin.** Arch. d'Opht. etc., 1938, v. 2, July, p. 606.

By education of the masses, changing their primitive habits of hygiene and sanitation, especially family overcrowding, and attenuating the influence of climatic conditions, the author believes trachoma can be eradicated. He visualizes a benevolent state organization by which the natives will be glad to be regimented voluntarily provided they understand what it is all about.

Derrick Vail.

Koslowski, Bogumil. **Epidemiology of trachoma.** Klinika Oczna, 1938, v. 16, pt. 3, p. 375.

A review of the various statistics on the prevalence of trachoma, with a detailed study of its prevalence in Poland. That country has 400,000 trachoma patients, 100,000 of whom have been treated in its 700 dispensaries.

Ray K. Daily.

Lystad, Harald. **Sigurd Hagen.** Acta Ophth., 1938, v. 16, pts. 2-3, pp. 185-187.

An obituary.

Masters, R. J. **Lessons learned from a blind-school survey.** Illinois Med. Jour., 1937, v. 72, Oct., p. 309.

Masters lists the causes of preventable blindness and advises the following measures to lessen blindness at an early stage: routine blood Wassermann upon every pregnant woman and treatment of mother and child if positive, Credé method immediately after delivery, routine examination of the eyes during febrile diseases, and investigation of all cases of red eye.

Theodore M. Shapira.

Zachert, Marian. **The distribution of ophthalmologists in Poland.** Klinika Oczna, 1938, v. 16, pt. 3, p. 385.

The number of ophthalmologists in Poland has increased 50 percent within the last five years, but Poland still has fewer ophthalmologists in proportion to population than any other civilized country. Eight cities with a population between twenty-five and fifty thousand have no ophthalmologist at all. Thirty-four percent of the ophthalmologists are women. Ray K. Daily.

19

ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Favaloro, Giuseppe. **A personal conception of the histogenesis of neuroglia.** Rassegna Ital. d'Ottal., 1938, v. 7, March-April, p. 161.

The author offers his personal interpretation of the histogenesis of the neuroglia normally encountered in the optic nerve and chiasm of man and the higher animals. He believes the diverse morphologic and structural aspects to be an expression of differentiation of the primitive epithelial elements, which range from this element itself not yet differentiated, into the various phases and forms of spongioblasts. These forms, fusiform, pyramidal, and oligodendrocytes, represent incomplete differentiation. The astrocyte represents the definitive element, completely differentiated. Eugene M. Blake.

Krümmel, H. **The nerves of the human ciliary body. A contribution to the neurohistology of smooth musculature.** Graefe's Arch., 1938, v. 138, pt. 6, pp. 845-865.

In an individual executed by decapitation, the tissues were fixed by injection of the empty carotid with formalin. For demonstration of the nerves, tangential sections 10 to 15 microns thick through the ciliary body were stained according to the silver-impregnation method of Bielschowsky and Gros. The article is illustrated with 25 drawings showing very plainly the arrangement of the nerve fibrils in the ciliary plexus, their varicosities and nodal points (where divisions occur), pericellular networks, ganglion cells, sheath plasmodia, sensory endings, and terminal nerve reticula in the ciliary muscle.

H. D. Lamb.

O'Day, Kevin. **The visual cells of the Platypus (ornithorhynchus).** Brit. Jour. Ophth., 1938, v. 22, June, pp. 321-328.

The investigations presented were carried out in the Anatomy Department of the University of Melbourne. Twin cones of the trout, double cone of the pigeon, visual cells of the platypus, and twin cones of the Australian native cat are described and illustrated. The find-

ings do not lend themselves to abstract. (Figures, references.)

D. F. Harbridge.

Winckler, Georges. **New research on morphology and topography of certain elements of the orbital region.** Ann. d'Ocul., 1938, v. 175, May, pp. 368-379.

This paper is a detailed description of anatomic investigations of the musculature of the lids, which is divided into five palpebral portions and one orbital portion; of the external palpebral ligament; of the muscle sheaths; and of Tenon's capsule. John M. McLean.

NEWS ITEMS

Edited by Dr. H. Rommel Hildreth
640 S. Kingshighway, Saint Louis

News items should reach the Editor by the twelfth of the month

Deaths

Dr. Joseph James Scroggs, Beaver, Pa., died July 19, 1938, aged 61 years.

Dr. Elmer G. Starr, Pasadena, Calif., died July 21, 1938, aged 77 years.

Societies

The Sixteenth Annual Meeting and Scientific Session of the Academy of Physical Medicine met in Washington, D.C., on October 24, 25, 26, 1938. Dr. Clifford B. Walker presented a paper, "The use of ultraviolet and short wave in ocular conditions."

Personals

Dr. Brittain Ford Payne announces the removal of his office to 896 Madison Avenue at 72d Street, New York.

The Royal Society of Medicine, Section of Ophthalmology, elected as its president, for 1938-1939, Malcolm Hepburn.

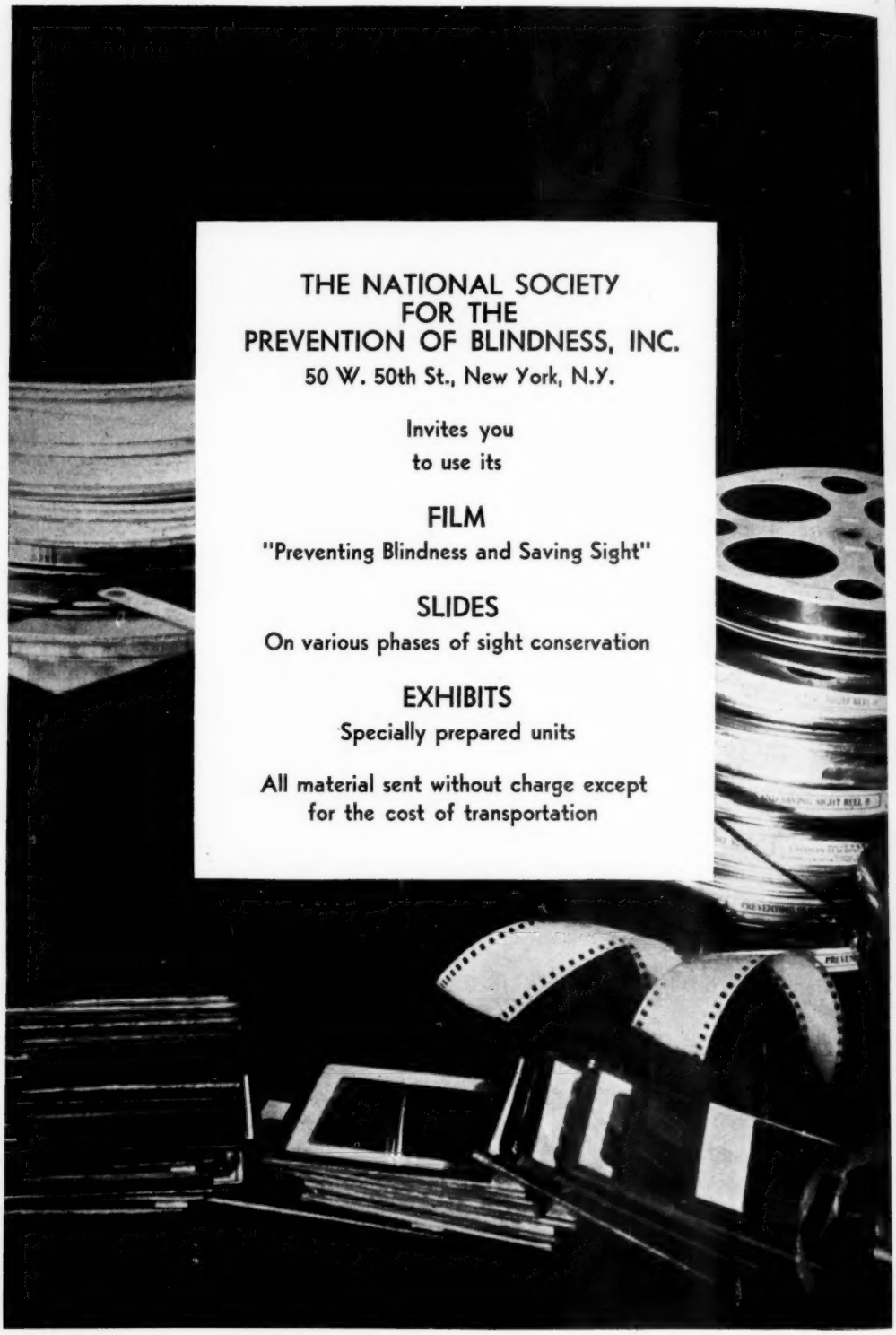
The Royal London Ophthalmic Hospital has appointed Mr. R. Affleck Greeves as consulting surgeon and Mr. J. H. Doggart and Mr. Harold Lloyd Ridley, assistant surgeons. The Oxford Eye Hospital has appointed Mr. C. G. Russ Wood consulting surgeon, and Mr. A. C. L. Houlton, assistant surgeon.

Mr. Adrian Caddy, F.R.C.S. was recently appointed as an examiner for the D.O.M.S. Part 11, by the Royal College of Surgeons.

Mr. J. Minton has been appointed honorary ophthalmic surgeon to the Queen's Hospital for Children, London.

Glasgow University offered courses in ophthalmology, covering glaucoma, cataract, retinitis, keratitis, and ocular new growths from September 6 to October 11.

Dr. Gordon Norrie, of Copenhagen, has retired after 35 years of service as surgeon to the Royal Institute for the Blind.


THE NATIONAL SOCIETY
FOR THE
PREVENTION OF BLINDNESS, INC.
50 W. 50th St., New York, N.Y.
Invites you
to use its
FILM
"Preventing Blindness and Saving Sight"
SLIDES
On various phases of sight conservation
EXHIBITS
Specially prepared units
All material sent without charge except
for the cost of transportation